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Test report

249235-1TRFWL

Date of issue: December 19, 2013

Applicant:

Redline Communications Inc.

Product:

Broadband Wireless Infrastructure Product

Model:

RDL-3000-RMD

FCC ID:

QC8-RDL3000RMD

Specification:

FCC Part 90, Subpart Z

Private land mobile radio services. Wireless broadband services in the 3650–3700 MHz band

Test location

Company name:	Nemko Canada Inc.
Address:	303 River Road
City:	Ottawa
Province:	Ontario
Postal code:	K1V 1H2
Country:	Canada
Telephone:	+1 613 737 9680
Facsimile:	+1 613 737 9691
Toll free:	+1 800 563 6336
Website:	www.nemko.com
Site number:	176392 (3 m semi anechoic chamber)

Tested by:	Kevin Rose, Wireless/EMC Specialist
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist
Date:	December 19, 2013
Signature:	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and Manufacturer

Company name:	Redline Communications Inc.
Address:	302 Town Center Blvd.
City:	Markham
Province/State:	Ontario
Postal/Zip code:	L3R 0E8
Country:	Canada

1.2 Test specifications

FCC Part 90, Subpart Z	Private land mobile radio services. Wireless broadband services in the 3650–3700 MHZ band

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 90, tests results

Clause	Test description	Verdict
90.209	Occupied bandwidth	Pass
90.210(b)	Emission mask	Pass
90.213(a)	Frequency stability	Pass
90.1321	Power and antenna limits	Pass
90.1323	Emission limits	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	December 2, 2013
Nemko sample ID number	1

3.2 EUT information

Product name	Broadband wireless infrastructure product
Model	RDL-3000-RMD

3.3 Technical information

Operating band	3675–3700 MHz
Operating frequencies	5 MHz (3677.5–3697.5 MHz) and 10 MHz (3680–3695 MHz)
Modulation type	OFDM using BPSK, QPSK 16-QAM, and 64-QAM modulations
Channel bandwidth	5 MHz, and 10 MHz
Occupied bandwidth (99 %)	5 MHz (4.18 MHz), and 10 MHz (8.22 MHz)
Emission designator	W7D
Power requirements	48 V_{DC}
MIMO type	2 × 2 with completely uncorrelated type of signal
Antenna information	Redline AFS-DBG-03120-01 Antenna Sectoral 3.3-3.8GHz 14dBi 2ft(60cm), Dual Polarization Redline AFS-DBG-0360-01 Antenna Sectoral 3.3-3.8GHz 15.5dBi 2ft(60cm), Dual Polarization Redline AFS-DBG-0390-01 Antenna Sectoral 3.3-3.8GHz 15dBi 2ft(60cm), Dual Polarization Redline 30-00328-40, 3.3-3.8GHz, 14dBi, Dual Polarization

3.4 Product description and theory of operation

The EUT is a point-to-multipoint (PMP) carrier grade broadband wireless infrastructure product, designed to operate in 3650–3700 MHz band

3.5 EUT exercise details

The EUT was controlled from laptop via Ethernet. Software version 2.25.107

3.6 EUT setup diagram

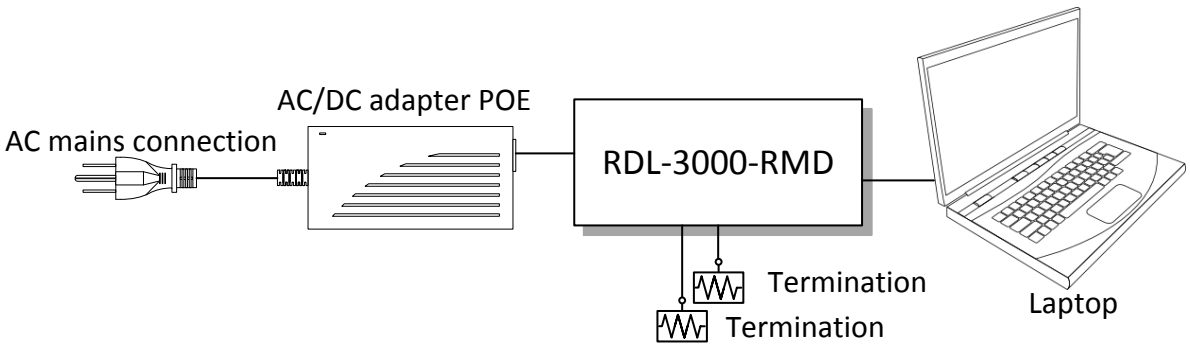


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
CINCON Power supply POE	Mean Well	TR60A-POE-L	-
Laptop	Dell	D630C	-

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/14
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power source	California Instruments	3001i	FA001021	1 year	June 04/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 16/14
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Feb. 21/14
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Feb. 21/14
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	2 year	Sept. 06/14
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Jan. 30/14

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 90.209 Occupied bandwidth

8.1.1 Definitions and limits

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

8.1.2 Test summary

Test date:	December 5, 2013	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

8.1.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	≥ 1 % of span
Video bandwidth:	≥3 × RBW
Frequency span:	30 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: 99 % bandwidth results for 5 MHz port 1

Modulation	Frequency, MHz	99 % bandwidth, MHz
BPSK	3677.5	4.14
	3685.0	4.16
	3697.5	4.14
QPSK	3677.5	4.14
	3685.0	4.14
	3697.5	4.14
16-QAM	3677.5	4.14
	3685.0	4.14
	3697.5	4.14
64-QAM	3677.5	4.14
	3685.0	4.14
	3697.5	4.14

Table 8.1-2: 99 % bandwidth results for 5 MHz port 2

Modulation	Frequency, MHz	99 % bandwidth, MHz
BPSK	3677.5	4.16
	3685.0	4.14
	3697.5	4.18
QPSK	3677.5	4.14
	3685.0	4.16
	3697.5	4.14
16-QAM	3677.5	4.14
	3685.0	4.16
	3697.5	4.14
64-QAM	3677.5	4.16
	3685.0	4.14
	3697.5	4.14

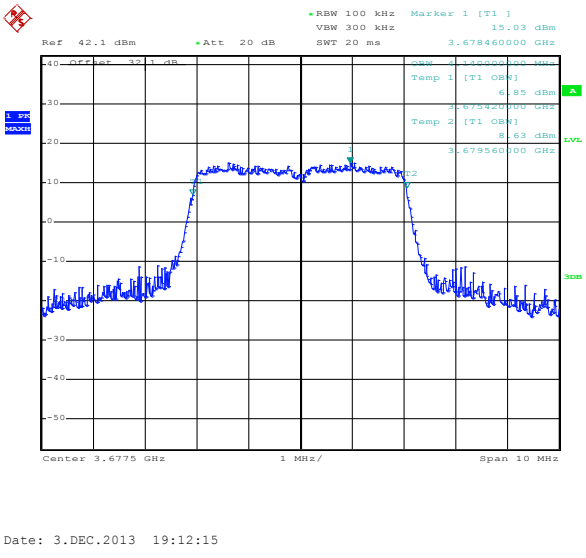


Figure 8.1-1: 99 % bandwidth, BPSK 5 MHz modulation sample

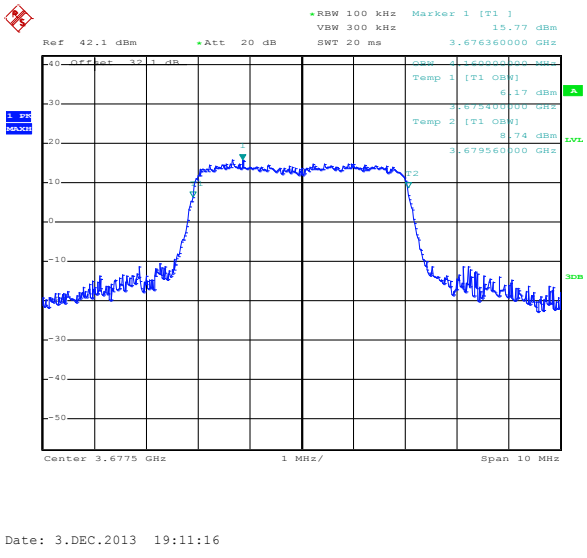


Figure 8.1-2: 99 % bandwidth, 64-QAM 5 MHz modulation sample

8.1.4 Test data continued

Table 8.1-3: 99 % bandwidth results for 10 MHz port 1

Modulation	Frequency, MHz	99 % bandwidth, MHz
BPSK	3680	8.22
	3685	8.18
	3695	8.20
QPSK	3680	8.20
	3685	8.18
	3695	8.18
16-QAM	3680	8.20
	3685	8.18
	3695	8.18
64-QAM	3680	8.20
	3685	8.18
	3695	8.20

Table 8.1-4: 99 % bandwidth results for 10 MHz port 2

Modulation	Frequency, MHz	99 % bandwidth, MHz
BPSK	3680	8.18
	3685	8.18
	3695	8.22
QPSK	3680	8.20
	3685	8.20
	3695	8.22
16-QAM	3680	8.20
	3685	8.22
	3695	8.18
64-QAM	3680	8.20
	3685	8.18
	3695	8.20

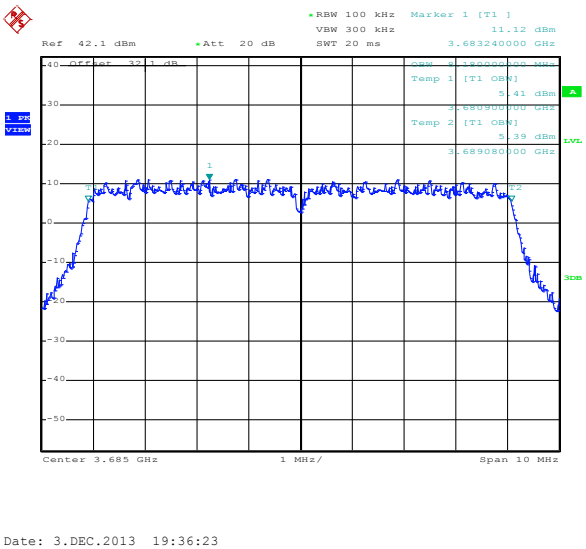


Figure 8.1-3: 99 % bandwidth, BPSK 10 MHz modulation sample

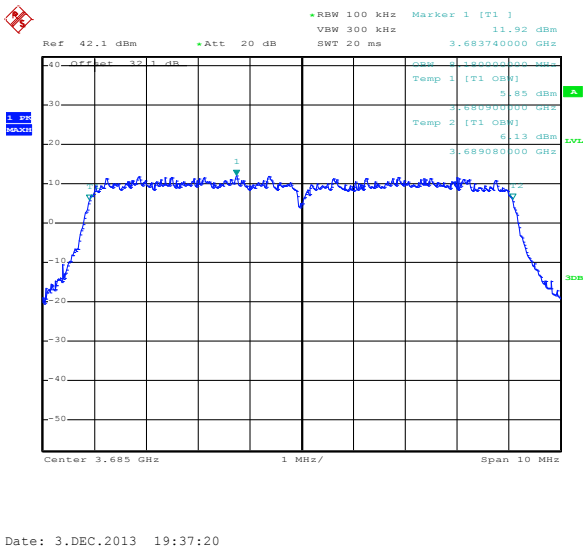


Figure 8.1-4: 99 % bandwidth, 64-QAM 10 MHz modulation sample

8.2 FCC 90.213(a) Transmitter frequency stability

8.2.1 Definitions and limits

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table:

Table 8.2-1: Minimum frequency stability

Frequency range (MHz)	Fixed and base stations (±ppm)	Mobile stations (±ppm)	
		Over 2 watts output power	2 watts or less output power
Below 25	100	100	200
25–50	20	20	50
72–76	5		50
150–174	5	5	50
216–220	1.0		1.0
220–222	0.1	1.5	1.5
421–512	2.5	5	5
806–809	1.0	1.5	1.5
809–824	1.5	2.5	2.5
851–854	1.0	1.5	1.5
854–869	1.5	2.5	2.5
896–901	0.1	1.5	1.5
902–928	2.5	2.5	2.5
902–928	2.5	2.5	2.5
929–930	1.5		
935–940	0.1	1.5	1.5
1427–1435	300	300	300
Above 2450			

8.2.2 Test summary

Test date:	December 3, 2013	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	35 %

8.2.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	20 kHz
Video bandwidth:	50 kHz
Frequency span:	2 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-2: Frequency drift measurement

Test conditions	Frequency, GHz	Drift, kHz
+50 °C, Nominal	3.675291667	-3.205
+40 °C, Nominal	3.675285256	-9.616
+30 °C, Nominal	3.675291667	-3.205
+20 °C, +15 %	3.675294872	0
+20 °C, Nominal	3.675294872	Reference
+20 °C, −15 %	3.675294872	0
+10 °C, Nominal	3.675307692	12.82
0 °C, Nominal	3.675317308	22.436
−10 °C, Nominal	3.675323718	28.846
−20 °C, Nominal	3.675330128	35.256
−30 °C, Nominal	3.675333333	38.461

Table 8.2-3: Frequency stability at lower band edge

BW, MHz	Port	Modulation	Lower cross point (f_L), GHz	Max negative drift, kHz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
5	0	BPSK	3.675294872	9.61	3.675285256	3.675	285.256
5	0	QPSK	3.675294872	9.61	3.675285256	3.675	285.256
5	0	16-QAM	3.675291667	9.61	3.675282051	3.675	282.051
5	0	64-QAM	3.675294872	9.61	3.675285256	3.675	285.256
5	1	BPSK	3.675288462	9.61	3.675278846	3.675	278.846
5	1	QPSK	3.675298077	9.61	3.675288461	3.675	288.461
5	1	16-QAM	3.675294872	9.61	3.675285256	3.675	285.256
5	1	64-QAM	3.675288462	9.61	3.675278846	3.675	278.846
10	0	BPSK	3.675719551	9.61	3.675709935	3.675	709.935
10	0	QPSK	3.675719551	9.61	3.675709935	3.675	709.935
10	0	16-QAM	3.675719551	9.61	3.675709935	3.675	709.935
10	0	64-QAM	3.675719551	9.61	3.675709935	3.675	709.935
10	1	BPSK	3.675615385	9.61	3.675605769	3.675	605.769
10	1	QPSK	3.675719551	9.61	3.675709935	3.675	709.935
10	1	16-QAM	3.675719551	9.61	3.675709935	3.675	709.935
10	1	64-QAM	3.675615385	9.61	3.675605769	3.675	605.769

Table 8.2-4: Frequency stability at upper band edge

BW, MHz	Port	Modulation	Upper cross point (f_H), GHz	Max positive drift, kHz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
5	0	BPSK	3.699685256	38.461	3.699723717	3.7	276.28
5	0	QPSK	3.699678846	38.461	3.699717307	3.7	282.69
5	0	16-QAM	3.699642051	38.461	3.699680512	3.7	319.49
5	0	64-QAM	3.699685256	38.461	3.699723717	3.7	276.28
5	1	BPSK	3.699733974	38.461	3.699772435	3.7	227.56
5	1	QPSK	3.699724694	38.461	3.699763155	3.7	236.84
5	1	16-QAM	3.699731568	38.461	3.699770029	3.7	229.97
5	1	64-QAM	3.699732857	38.461	3.699771318	3.7	228.68
10	0	BPSK	3.699249359	38.461	3.699287820	3.7	712.18
10	0	QPSK	3.699249359	38.461	3.699287820	3.7	712.18
10	0	16-QAM	3.699252564	38.461	3.699291025	3.7	708.97
10	0	64-QAM	3.699252564	38.461	3.699291025	3.7	708.97
10	1	BPSK	3.699258974	38.461	3.699297435	3.7	702.56
10	1	QPSK	3.699262179	38.461	3.699300640	3.7	699.36
10	1	16-QAM	3.699258974	38.461	3.699297435	3.7	702.56
10	1	64-QAM	3.699255769	38.461	3.699294230	3.7	705.77

8.2.4 Test data, continued

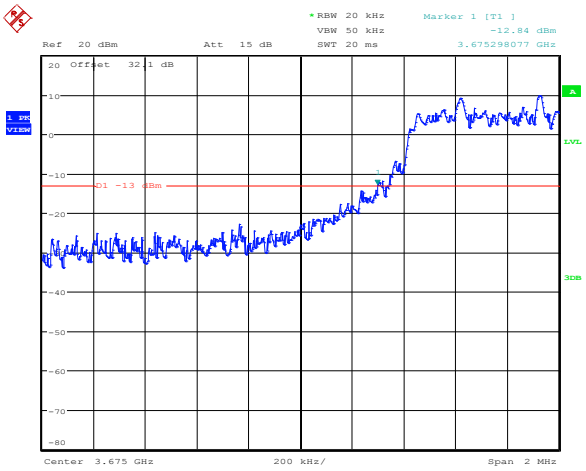


Figure 8.2-1: Lower cross point (f_L) sample plot for 5 MHz

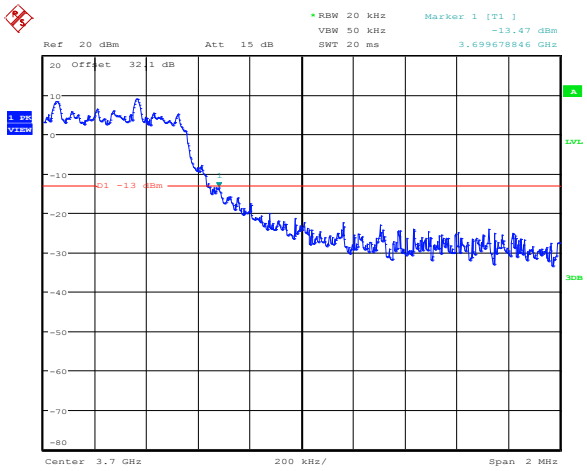


Figure 8.2-2: Upper cross point (f_H) sample plot for 5 MHz

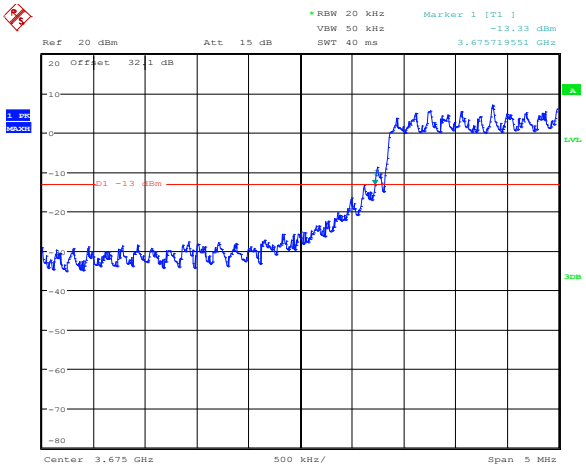


Figure 8.2-3: Upper cross point (f_L) sample plot for 10 MHz

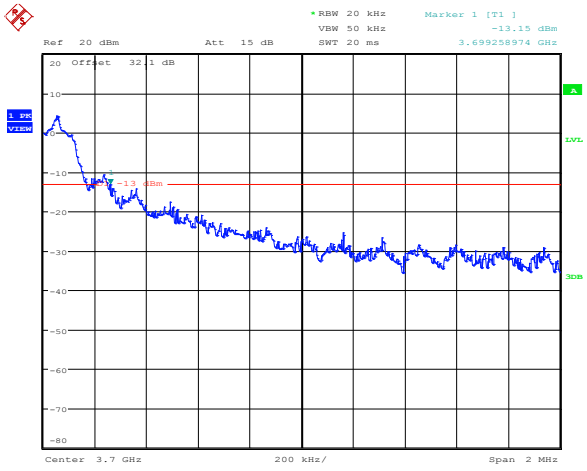


Figure 8.2-4: Upper cross point (f_H) sample plot for 10 MHz

8.3 FCC 90.1321(a) Transmit output power and PSD

8.3.1 Definitions and limits

a) Base and fixed stations are limited to 25 W/25 MHz equivalent isotropically radiated power (EIRP). In any event, the peak EIRP power density shall not exceed 1 W in any one-megahertz slice of spectrum.

(b) In addition to the provisions in paragraph (a) of this section, transmitters operating in the 3650–3700 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(1) Different information must be transmitted to each receiver.

(2) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (a) of this section, as applicable. The directional antenna gain shall be computed as follows:

(i) The directional gain, in dBi, shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain, in dBi, of the individual element or stave having the highest gain.

(ii) A lower value for the directional gain than that calculated in paragraph (b)(2)(i) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beam-forming.

(3) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels and if transmitted beams overlap, the power shall be reduced to ensure that the aggregate power from the overlapping beams does not exceed the limit specified in paragraph (b)(2) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (b)(2) of this section by more than 8 dB.

(4) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (b)(2) of this section.

8.3.2 Test summary

Test date:	December 3, 2013	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	35 %

8.3.3 Observations settings and special notes

The transmit power was measured in conducted mode, using and RMS detector, over a period of continuous transmission of sufficient duration such that the acquired trace is maximized. Video averaging was not allowed. Spectrum analyser settings:

Resolution bandwidth:	Wider than 99 % OBW
Video bandwidth:	≥ 3 times the RBW
Detector mode:	RMS
Trace mode:	Max Hold

The transmitter power spectral density was measured over a bandwidth of 1 MHz. With the power measured as per above. A resolution bandwidth less than the measurement bandwidth can be used provided that the measured power is integrated to show total power over the measurement bandwidth.
Spectrum analyser settings:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	RMS
Trace mode:	Max Hold

8.3.4 Test data

Table 8.3-1: EIRP measurements results for 5 MHz

Port	Modulation	Frequency, MHz	Power setting	Peak output power, dBm/5 MHz	EIRP limit, dBm/5 MHz	Margin, dB
1	BPSK	3677.5	23	22.66	37	14.34
		3685	23	22.32	37	14.68
		3697.5	23	22.35	37	14.65
	QPSK	3677.5	23	22.58	37	14.42
		3685	23	22.25	37	14.75
		3697.5	23	22.38	37	14.62
	16-QAM	3677.5	23	22.35	37	14.65
		3685	23	22.73	37	14.27
		3697.5	23	22.56	37	14.44
	64-QAM	3677.5	23	22.42	37	14.58
		3685	23	22.27	37	14.73
		3697.5	23	22.68	37	14.32
2	BPSK	3677.5	23	22.76	37	14.24
		3685	23	22.36	37	14.64
		3697.5	23	22.38	37	14.62
	QPSK	3677.5	23	22.74	37	14.26
		3685	23	22.63	37	14.37
		3697.5	23	22.59	37	14.41
	16-QAM	3677.5	23	22.82	37	14.18
		3685	23	22.59	37	14.41
		3697.5	23	22.47	37	14.53
	64-QAM	3677.5	23	22.73	37	14.27
		3685	23	22.52	37	14.48
		3697.5	23	22.48	37	14.52

Note: limit (25 W/25 MHz) = 44 dBm/25 MHz. Limit (5 W/5 MHz) = 37 dBm/5 MHz

8.3.4 Test data, continued

Table 8.3-2: EIRP PSD measurements results for 5 MHz

Port	Modulation	Frequency, MHz	Power setting	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
1	BPSK	3677.5	23	17.60	30	12.40
		3685	23	17.33	30	12.67
		3697.5	23	17.29	30	12.71
	QPSK	3677.5	23	17.53	30	12.47
		3685	23	17.31	30	12.69
		3697.5	23	17.33	30	12.67
	16-QAM	3677.5	23	17.31	30	12.69
		3685	23	17.58	30	12.42
		3697.5	23	17.42	30	12.58
	64-QAM	3677.5	23	17.27	30	12.73
		3685	23	17.45	30	12.55
		3697.5	23	17.69	30	12.31
2	BPSK	3677.5	23	17.74	30	12.26
		3685	23	17.32	30	12.68
		3697.5	23	17.36	30	12.64
	QPSK	3677.5	23	17.66	30	12.34
		3685	23	17.53	30	12.47
		3697.5	23	17.42	30	12.58
	16-QAM	3677.5	23	17.23	30	12.77
		3685	23	17.28	30	12.72
		3697.5	23	17.31	30	12.69
	64-QAM	3677.5	23	17.68	30	12.32
		3685	23	17.34	30	12.66
		3697.5	23	17.36	30	12.64

Note: The Maximum antenna gain per 5 MHz bandwidth the power setting of 23 is 12.26 dBi , if higher antenna gain is used the output power should be reduced by amounts of dB that the antenna gain is higher than 12.26 dBi.

8.3.4 Test data, continued

Table 8.3-3: EIRP measurements results for 10 MHz

Port	Modulation	Frequency, MHz	Power setting	Peak output power, dBm/10 MHz	EIRP limit, dBm/10 MHz	Margin, dB
1	BPSK	3680	23	22.22	40	17.78
		3685	23	22.33	40	17.67
		3695	23	22.04	40	17.96
	QPSK	3680	23	21.72	40	18.28
		3685	23	22.36	40	17.64
		3695	23	22.02	40	17.98
	16-QAM	3680	23	22.27	40	17.73
		3685	23	22.34	40	17.66
		3695	23	22.00	40	18.00
	64-QAM	3680	23	22.25	40	17.75
		3685	23	22.30	40	17.70
		3695	23	21.80	40	18.20
2	BPSK	3680	23	22.34	40	17.66
		3685	23	22.30	40	17.70
		3695	23	22.06	40	17.94
	QPSK	3680	23	22.37	40	17.63
		3685	23	22.36	40	17.64
		3695	23	22.07	40	17.93
	16-QAM	3680	23	22.42	40	17.58
		3685	23	22.33	40	17.67
		3695	23	22.00	40	18.00
	64-QAM	3680	23	22.52	40	17.48
		3685	23	22.41	40	17.59
		3695	23	22.12	40	17.88

Note: limit (25 W/25 MHz) = 44 dBm/25 MHz. Limit (10 W/10 MHz) = 40 dBm/10 MHz

8.3.4 Test data, continued

Table 8.3-4: EIRP PSD measurements results for 10 MHz

Port	Modulation	Frequency, MHz	Power setting	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
1	BPSK	3680	23	14.33	30	15.67
		3685	23	14.38	30	15.62
		3695	23	14.03	30	15.97
	QPSK	3680	23	13.69	30	16.31
		3685	23	14.39	30	15.61
		3695	23	14.02	30	15.98
	16-QAM	3680	23	14.42	30	15.58
		3685	23	14.49	30	15.51
		3695	23	14.03	30	15.97
	64-QAM	3680	23	14.37	30	15.63
		3685	23	14.43	30	15.57
		3695	23	13.90	30	16.10
2	BPSK	3680	23	14.59	30	15.41
		3685	23	14.52	30	15.48
		3695	23	14.07	30	15.93
	QPSK	3680	23	14.50	30	15.50
		3685	23	14.55	30	15.45
		3695	23	14.09	30	15.91
	16-QAM	3680	23	14.54	30	15.46
		3685	23	14.49	30	15.51
		3695	23	14.09	30	15.91
	64-QAM	3680	23	14.60	30	15.40
		3685	23	14.63	30	15.37
		3695	23	14.10	30	15.90

Note: The Maximum antenna gain per10 MHz bandwidth the power setting of 23 is 15.37 dBi, if higher antenna gain is used the output power should be reduced by amounts of dB that the antenna gain is higher than 15.37 dBi.

8.3.4 Test data, continued

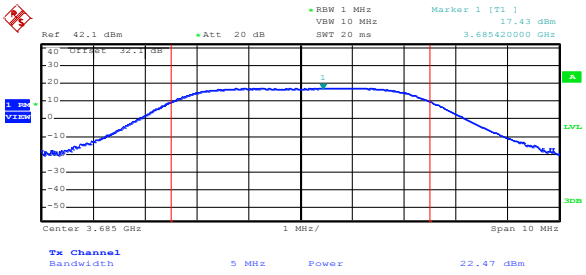


Figure 8.3-1: Output power and PSD 5 MHz sample plot with BPSK

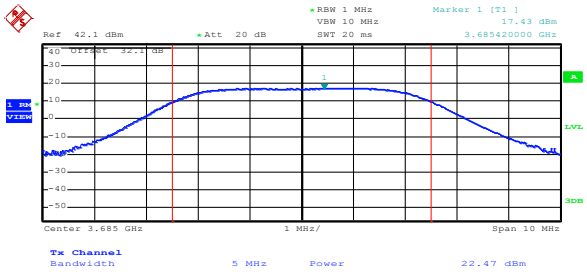


Figure 8.3-2: Output power and PSD 5 MHz sample plot with QPSK

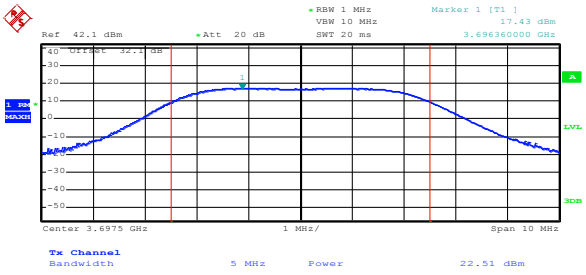


Figure 8.3-3: Output power and PSD 5 MHz sample plot with 16QAM

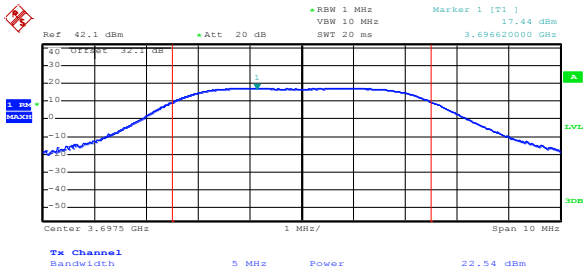


Figure 8.3-4: Output power and PSD 5 MHz sample plot with 64QAM

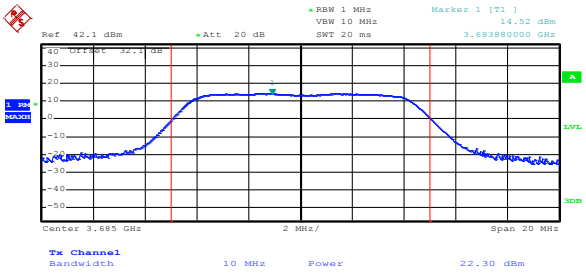


Figure 8.3-5: Output power and PSD 10 MHz sample plot with BPSK

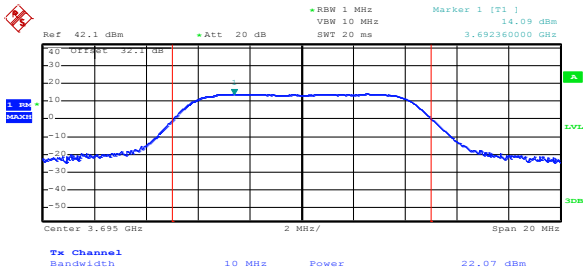


Figure 8.3-6: Output power and PSD 10 MHz sample plot with QPSK

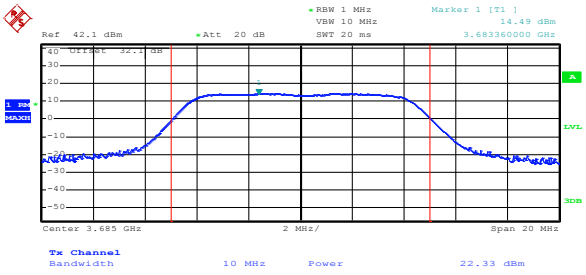


Figure 8.3-7: Output power and PSD 10 MHz sample plot with 16QAM

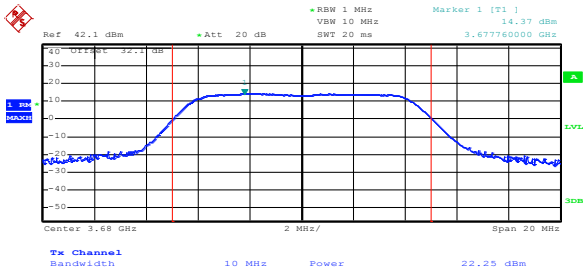


Figure 8.3-8: Output power and PSD 10 MHz sample plot with 64QAM

8.4 FCC 90.210(b) Emission mask

8.4.1 Definitions and limits

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

8.4.2 Test summary

Test date:	December 3, 2013	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	35 %

8.4.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	1 MHz
Detector mode:	RMS
Trace mode:	Power averaging over 100 sweeps

8.4.4 Test data

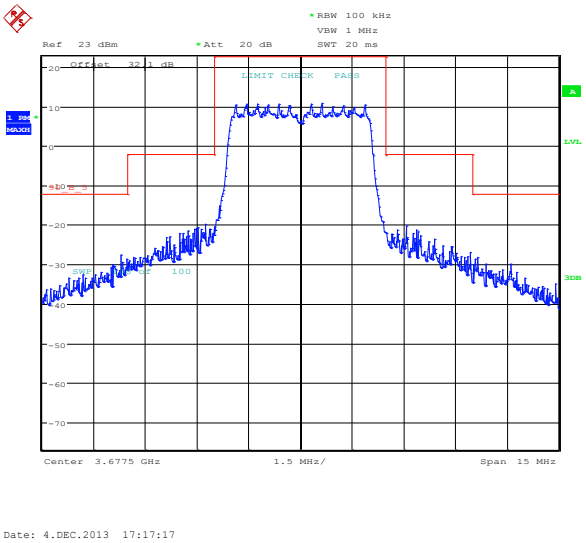


Figure 8.4-1: Emission mask at Port 1 5 MHz with BPSK, low channel

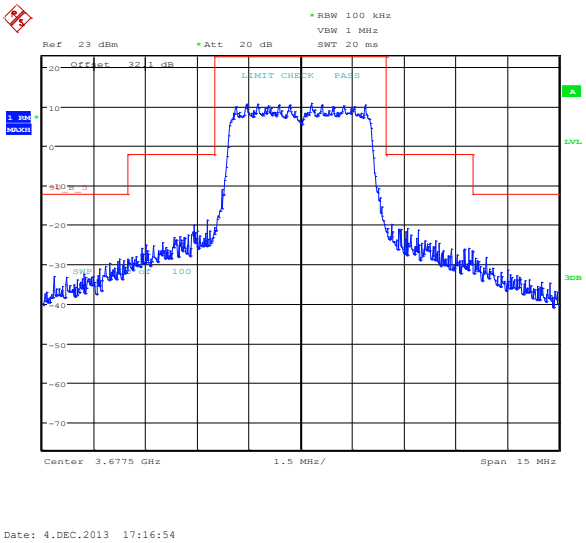


Figure 8.4-2: Emission mask at Port 1 5 MHz with QPSK, low channel

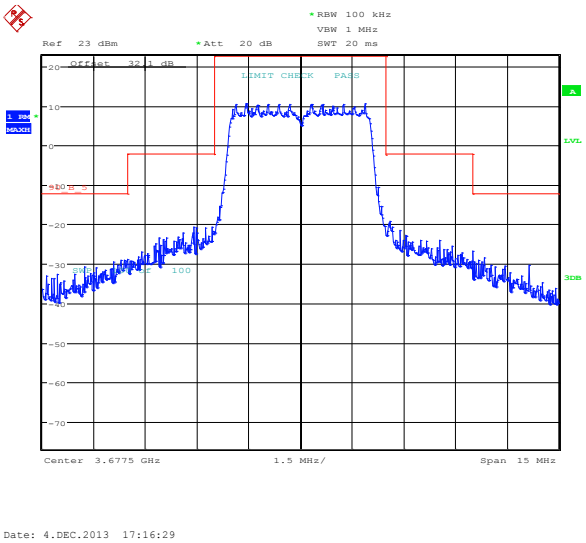


Figure 8.4-3: Emission mask at Port 1 5 MHz with 16-QAM, low channel

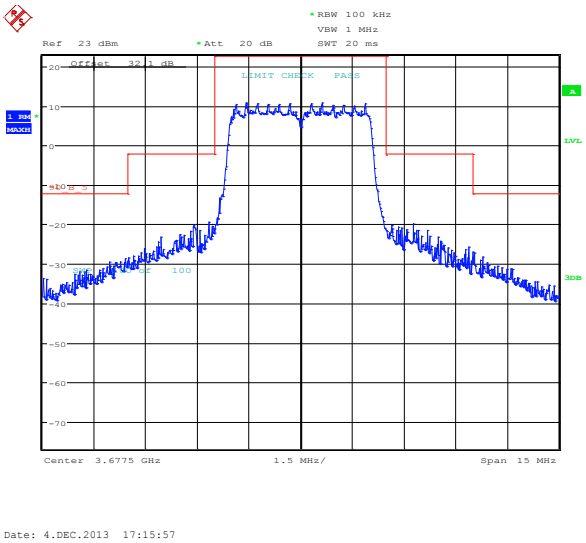


Figure 8.4-4: Emission mask at Port 1 5 MHz with 64-QAM, low channel

8.4.4 Test data, continued

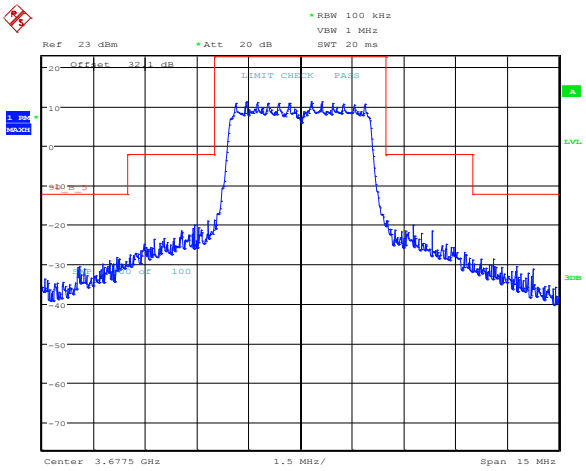


Figure 8.4-5: Emission mask at Port 2 5 MHz with BPSK, low channel

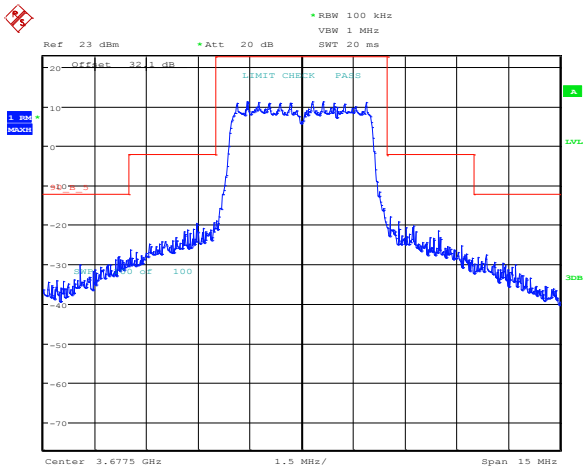


Figure 8.4-6: Emission mask at Port 2 5 MHz with QPSK, low channel

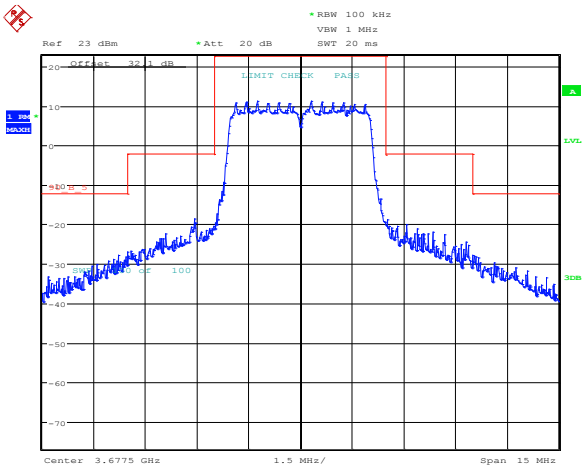


Figure 8.4-7: Emission mask at Port 2 5 MHz with 16-QAM, low channel

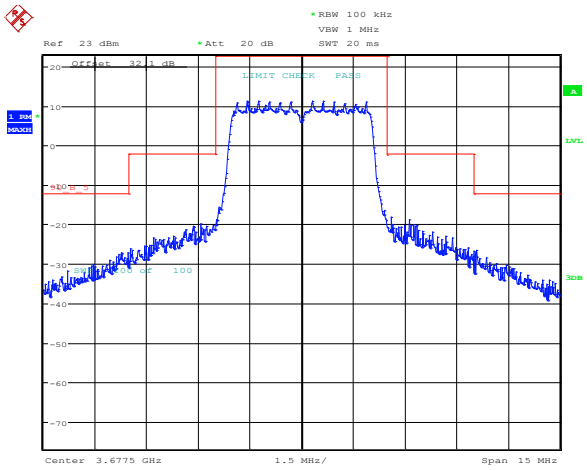


Figure 8.4-8: Emission mask at Port 2 5 MHz with 64-QAM, low channel

8.4.4 Test data, continued

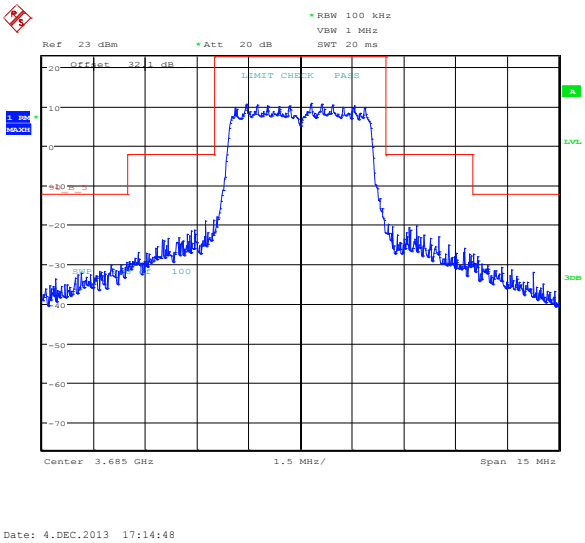


Figure 8.4-9: Emission mask at Port 1 5 MHz with BPSK, Mid channel

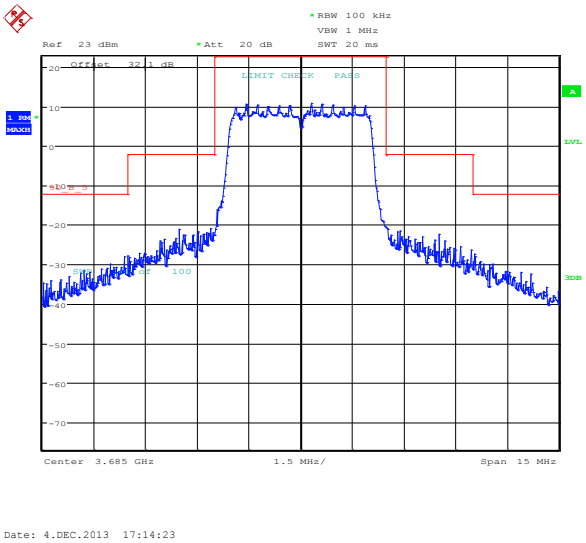


Figure 8.4-10: Emission mask at Port 1 5 MHz with QPSK, Mid channel

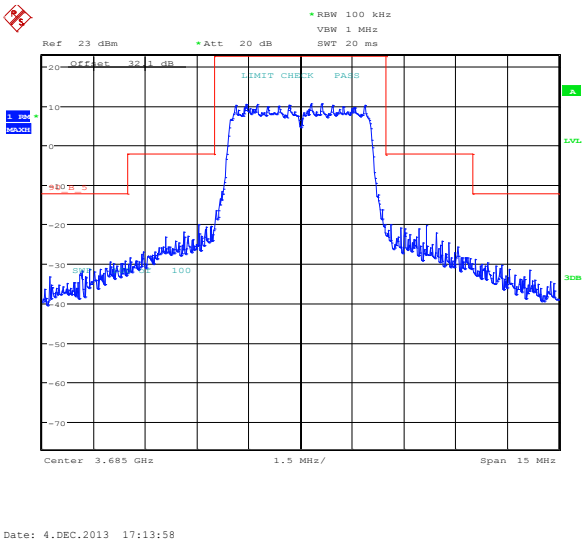


Figure 8.4-11: Emission mask at Port 1 5 MHz with 16-QAM, Mid channel

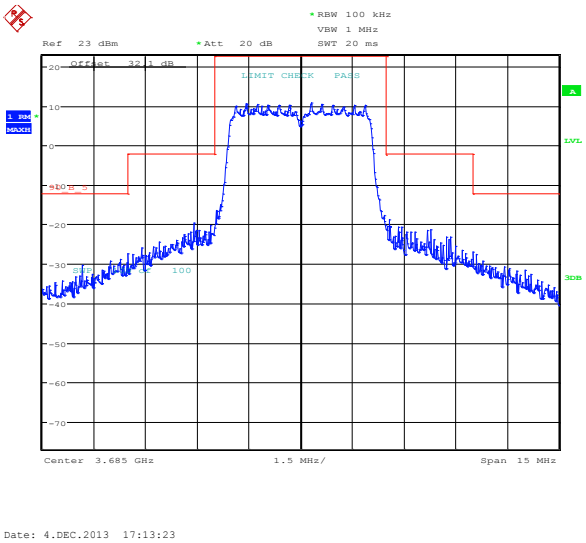


Figure 8.4-12: Emission mask at Port 1 5 MHz with 64-QAM, Mid channel

8.4.4 Test data, continued

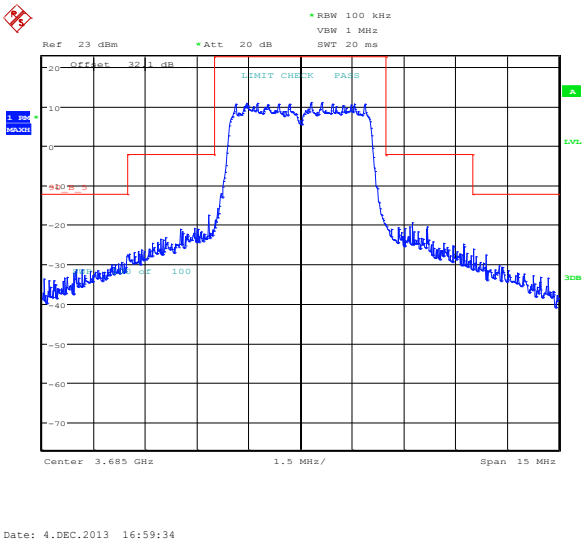


Figure 8.4-13: Emission mask at Port 2 5 MHz with BPSK, Mid channel

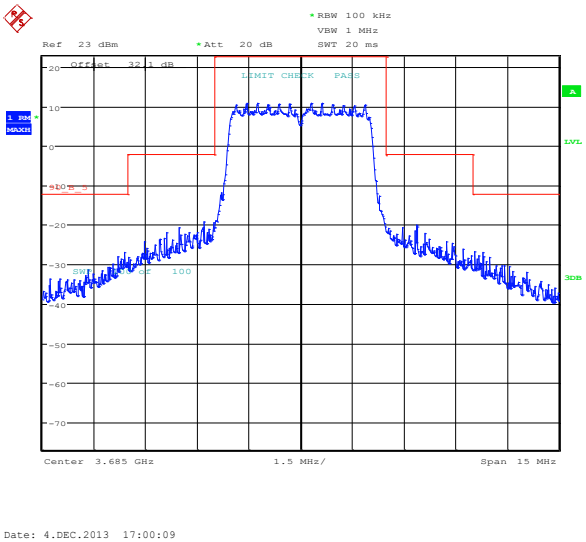


Figure 8.4-14: Emission mask at Port 2 5 MHz with QPSK, Mid channel

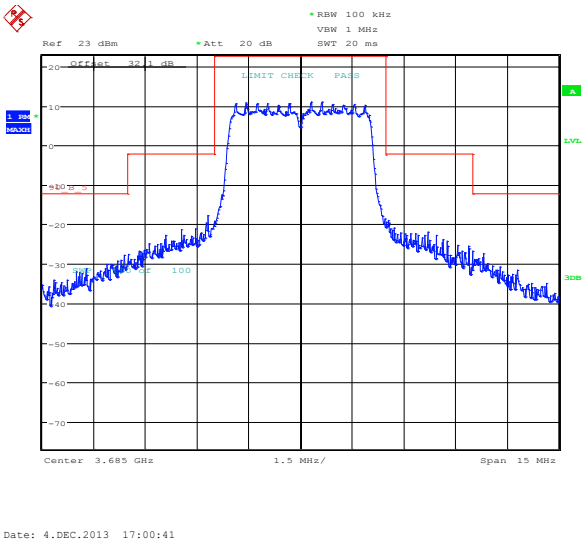


Figure 8.4-15: Emission mask at Port 2 5 MHz with 16-QAM, Mid channel

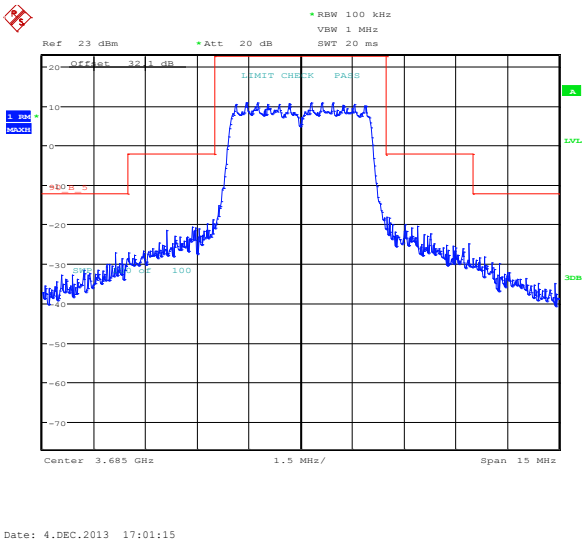


Figure 8.4-16: Emission mask at Port 2 5 MHz with 64-QAM, Mid channel

8.4.4 Test data, continued

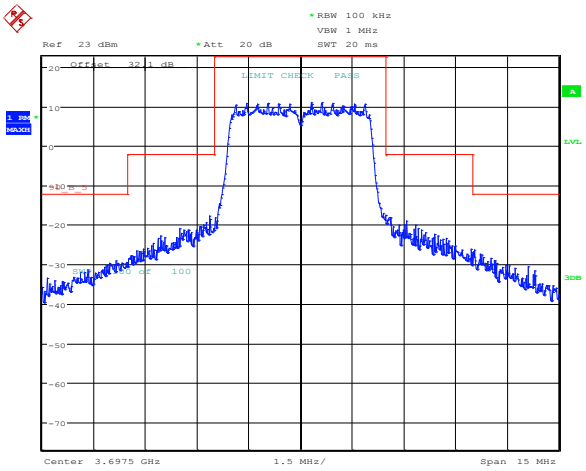


Figure 8.4-17: Emission mask at Port 1 5 MHz with BPSK, High channel

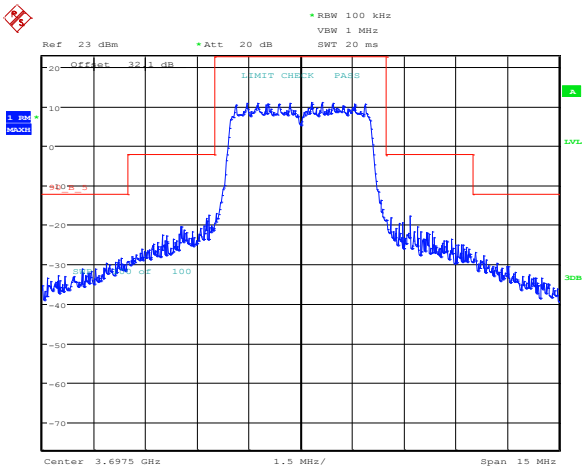


Figure 8.4-18: Emission mask at Port 1 5 MHz with QPSK, High channel

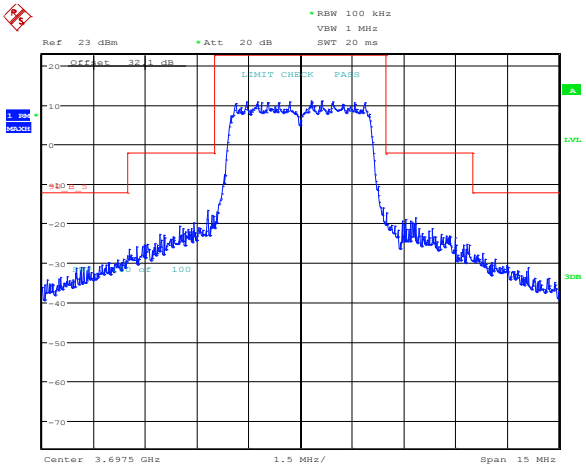


Figure 8.4-19: Emission mask at Port 1 5 MHz with 16-QAM, High channel

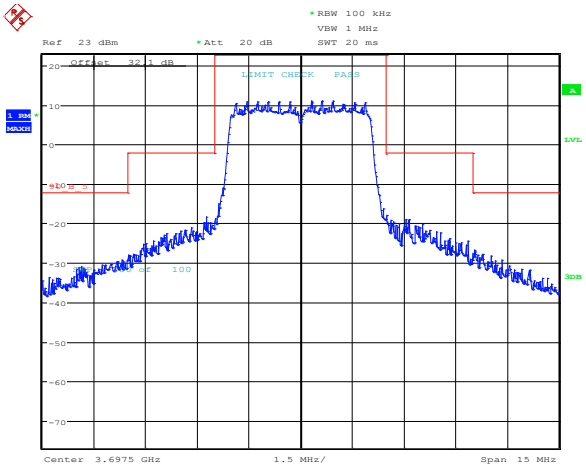


Figure 8.4-20: Emission mask at Port 1 5 MHz with 64-QAM, High channel

8.4.4 Test data, continued

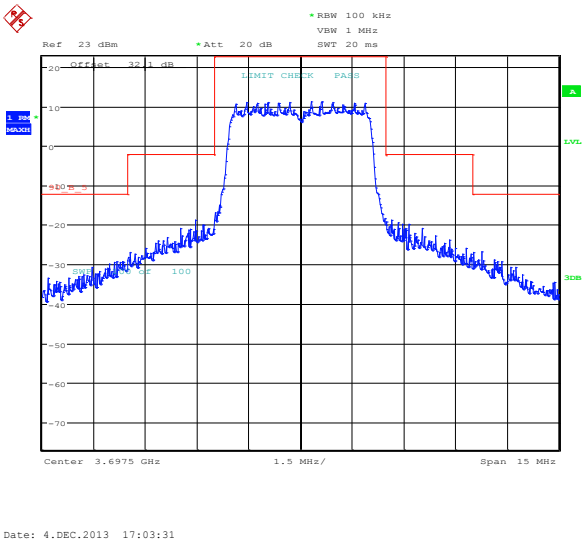


Figure 8.4-21: Emission mask at Port 2 5 MHz with BPSK, High channel

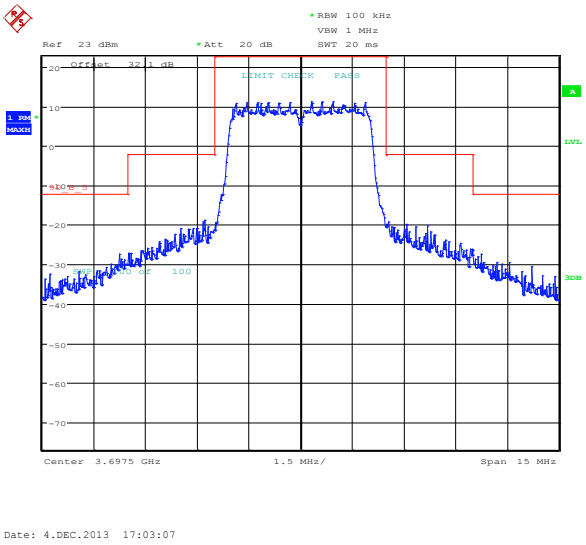


Figure 8.4-22: Emission mask at Port 2 5 MHz with QPSK, High channel

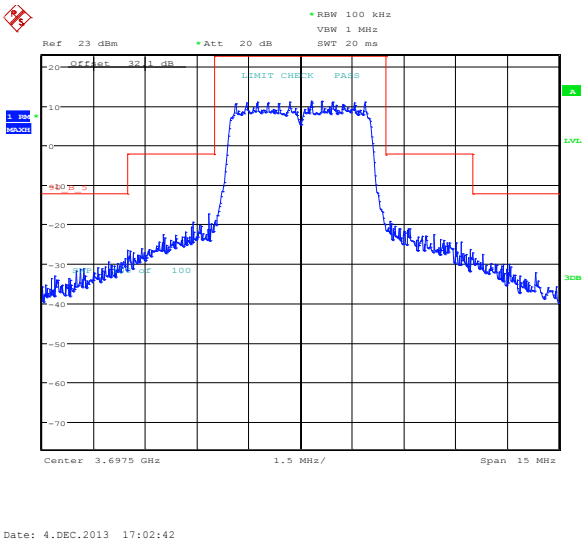


Figure 8.4-23: Emission mask at Port 2 5 MHz with 16-QAM, High channel

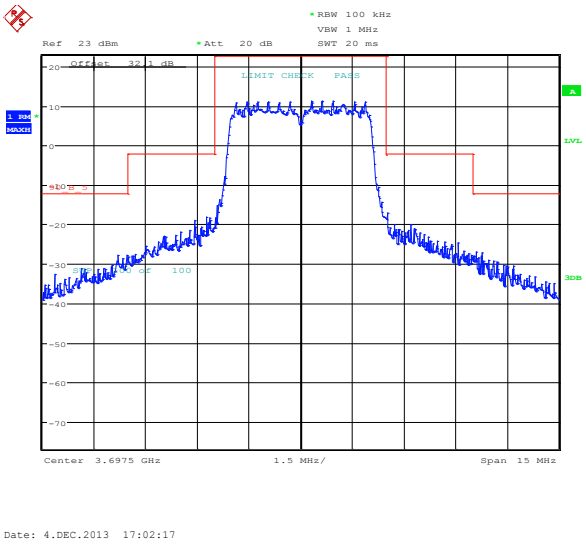


Figure 8.4-24: Emission mask at Port 2 5 MHz with 64-QAM, High channel

8.4.4 Test data

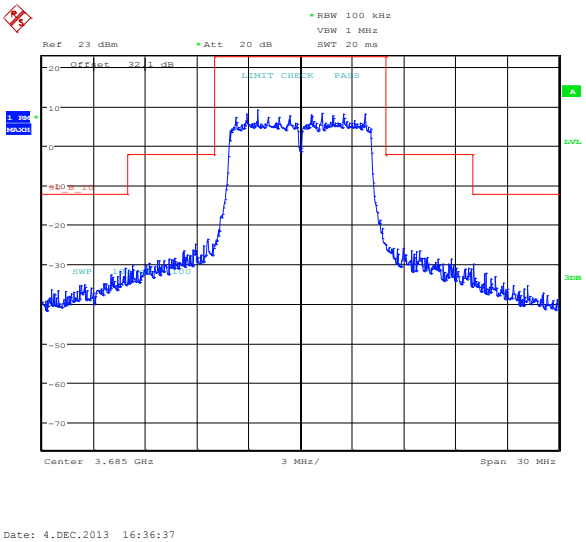


Figure 8.4-25: Emission mask at Port 1 10 MHz with BPSK, low channel

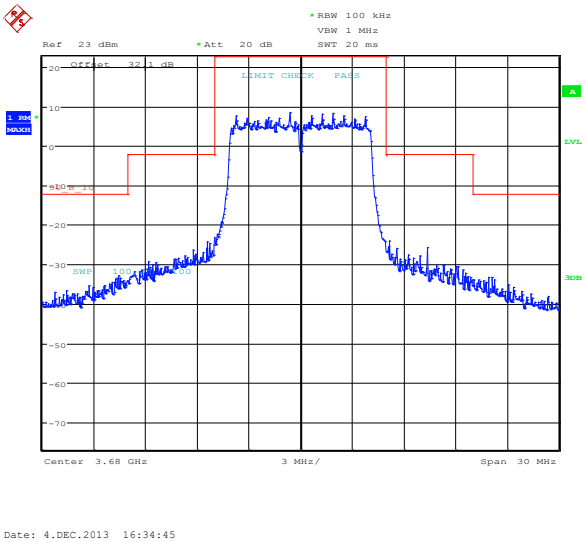


Figure 8.4-26: Emission mask at Port 1 10 MHz with QPSK, low channel

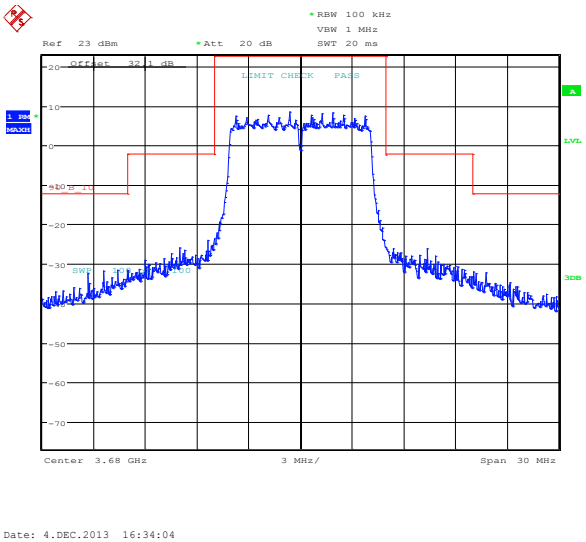


Figure 8.4-27: Emission mask at Port 1 10 MHz with 16-QAM, low channel

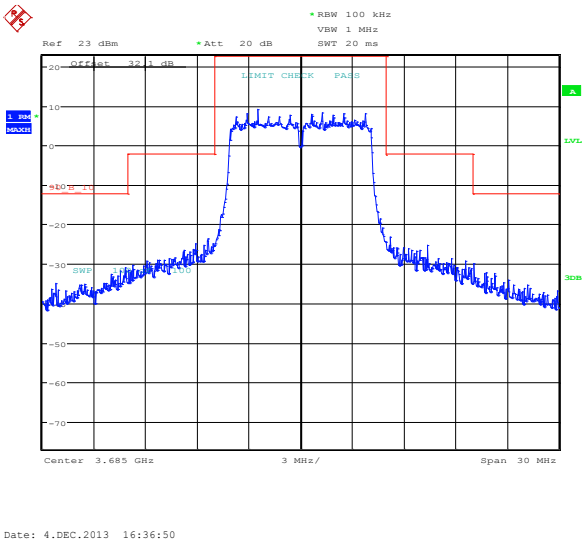


Figure 8.4-28: Emission mask at Port 1 10 MHz with 64-QAM, low channel

8.4.4 Test data, continued

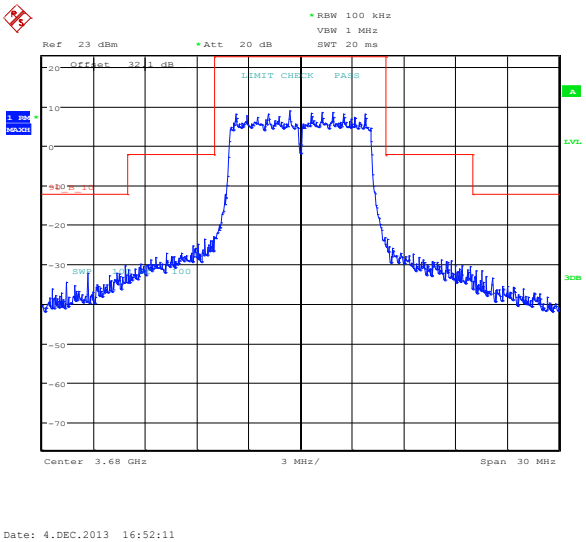


Figure 8.4-29: Emission mask at Port 2 10 MHz with BPSK, low channel

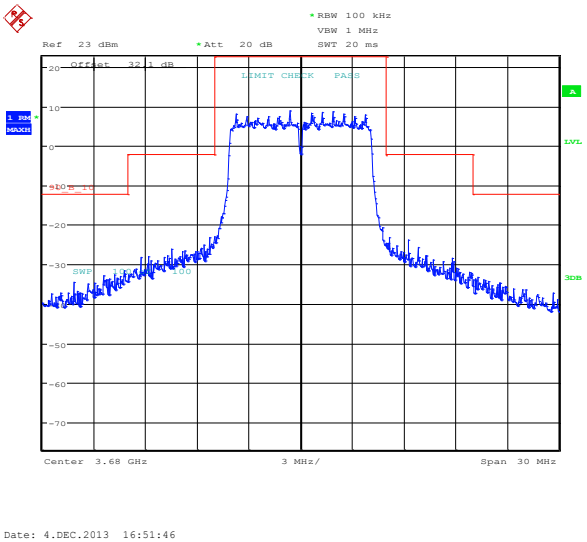


Figure 8.4-30: Emission mask at Port 2 10 MHz with QPSK, low channel

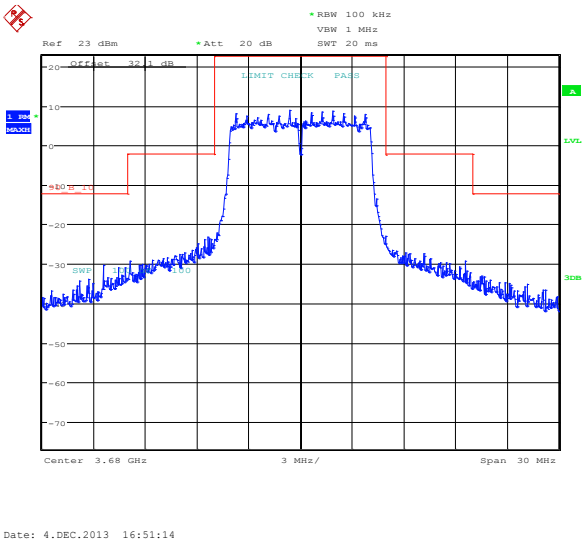


Figure 8.4-31: Emission mask at Port 2 10 MHz with 16-QAM, low channel

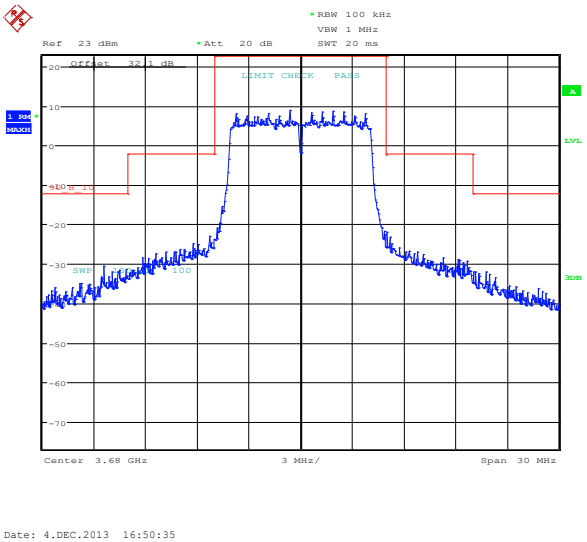


Figure 8.4-32: Emission mask at Port 2 10 MHz with 64-QAM, low channel

8.4.4 Test data, continued

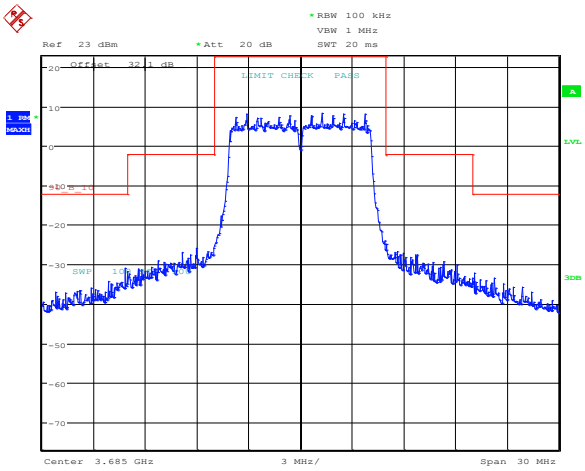


Figure 8.4-33: Emission mask at Port 1 10 MHz with BPSK, Mid channel

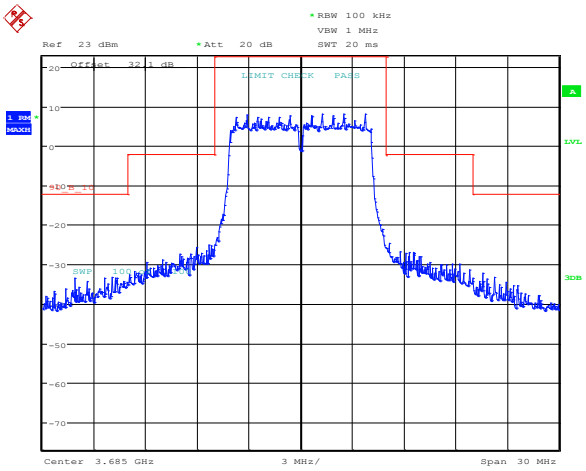


Figure 8.4-34: Emission mask at Port 1 10 MHz with QPSK, Mid channel

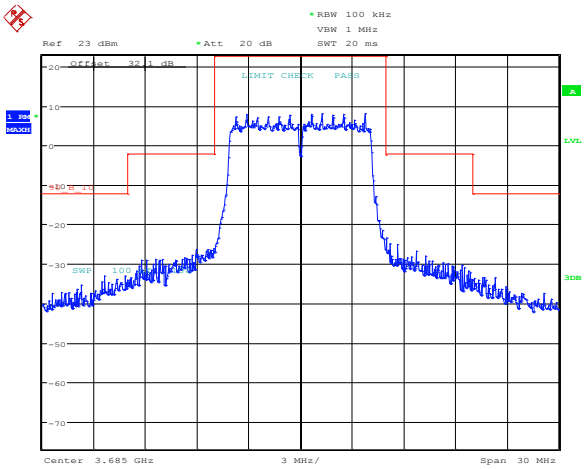


Figure 8.4-35: Emission mask at Port 1 10 MHz with 16-QAM, Mid channel

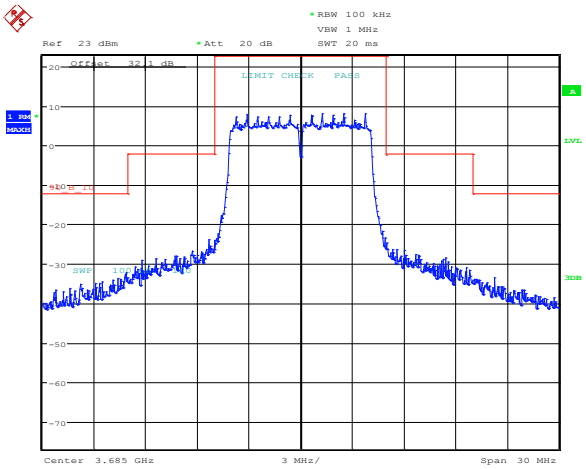


Figure 8.4-36: Emission mask at Port 1 10 MHz with 64-QAM, Mid channel

8.4.4 Test data, continued

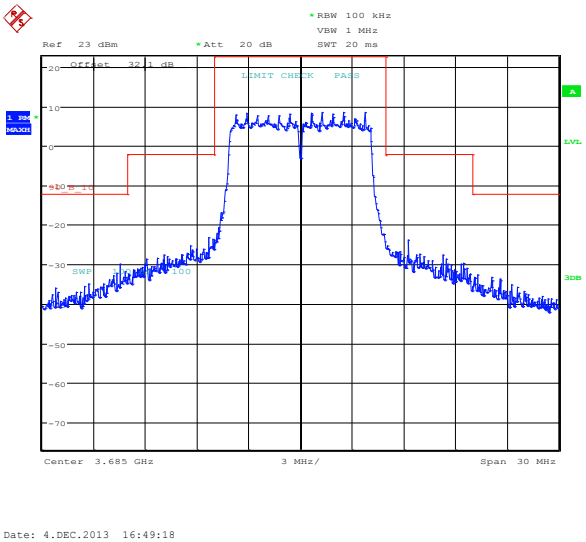


Figure 8.4-37: Emission mask at Port 2 10 MHz with BPSK, Mid channel

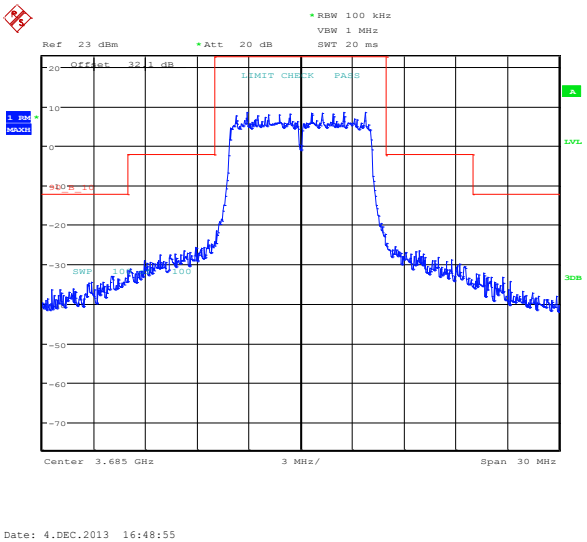


Figure 8.4-38: Emission mask at Port 2 10 MHz with QPSK, Mid channel

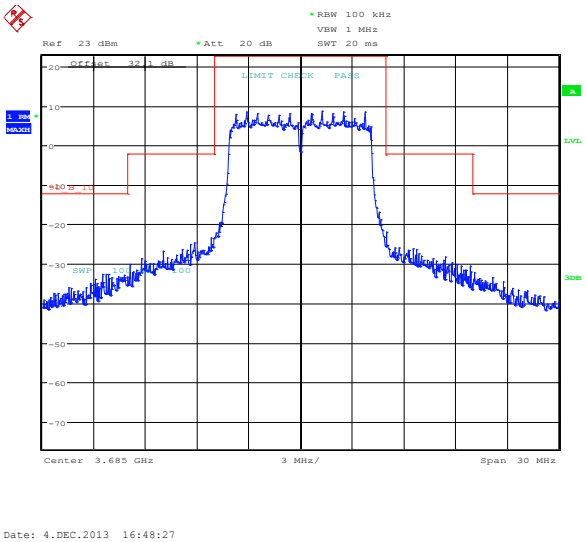


Figure 8.4-39: Emission mask at Port 2 10 MHz with 16-QAM, Mid channel

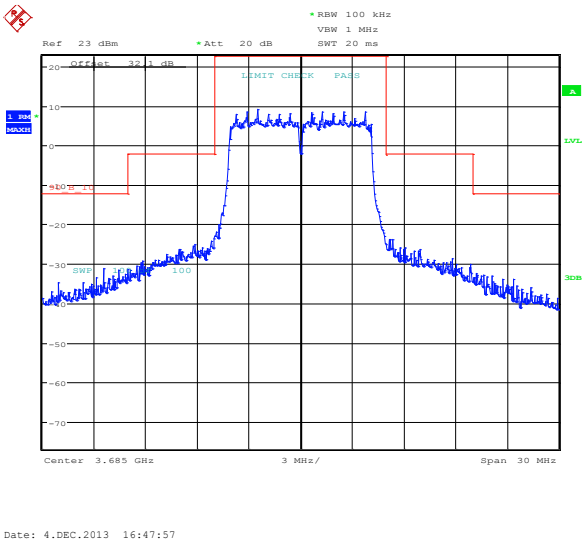


Figure 8.4-40: Emission mask at Port 2 10 MHz with 64-QAM, Mid channel

8.4.4 Test data, continued

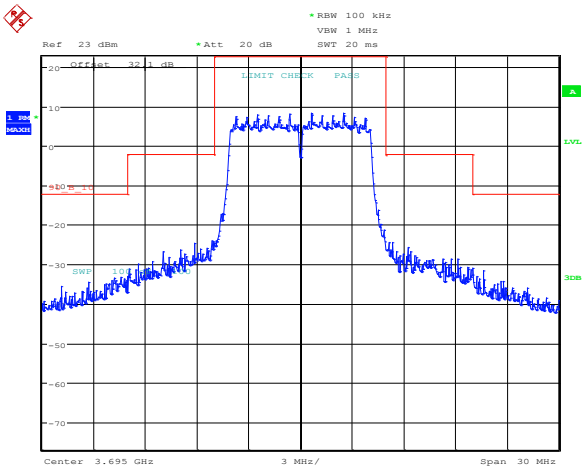


Figure 8.4-41: Emission mask at Port 1 10 MHz with BPSK, High channel

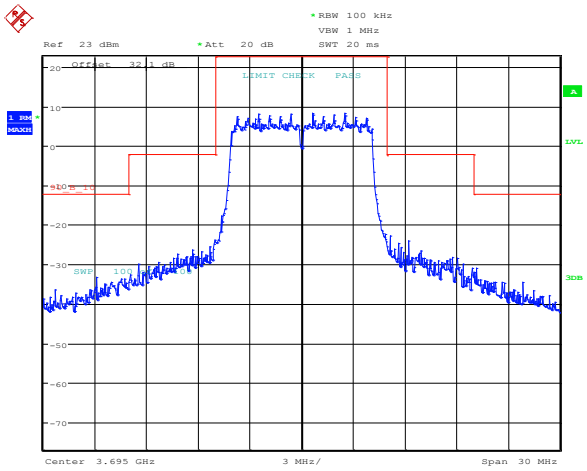


Figure 8.4-42: Emission mask at Port 1 10 MHz with, QPSK, High channel

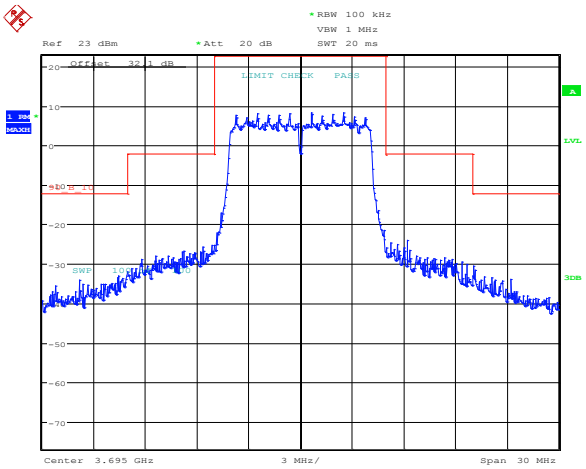


Figure 8.4-43: Emission mask at Port 1 10 MHz with 16-QAM, High channel

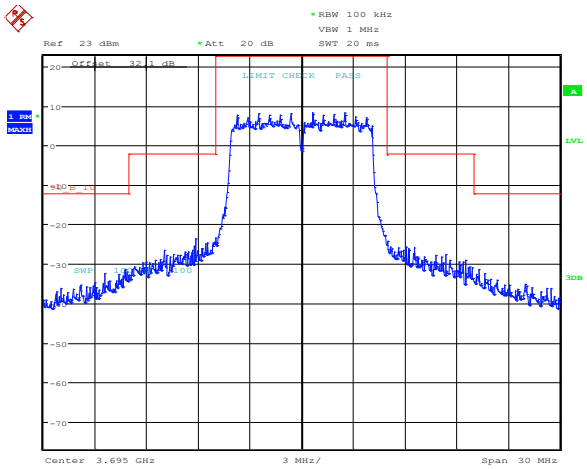


Figure 8.4-44: Emission mask at Port 1 10 MHz with 64-QAM, High channel

8.4.4 Test data, continued

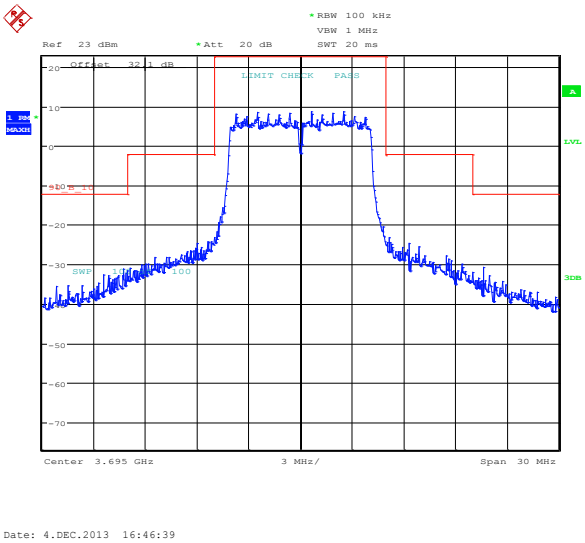


Figure 8.4-45: Emission mask at Port 2 10 MHz with BPSK, High channel

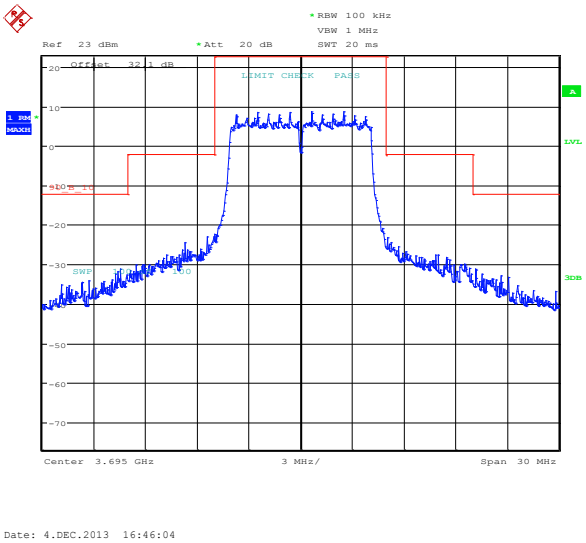


Figure 8.4-46: Emission mask at Port 2 10 MHz with QPSK, High channel

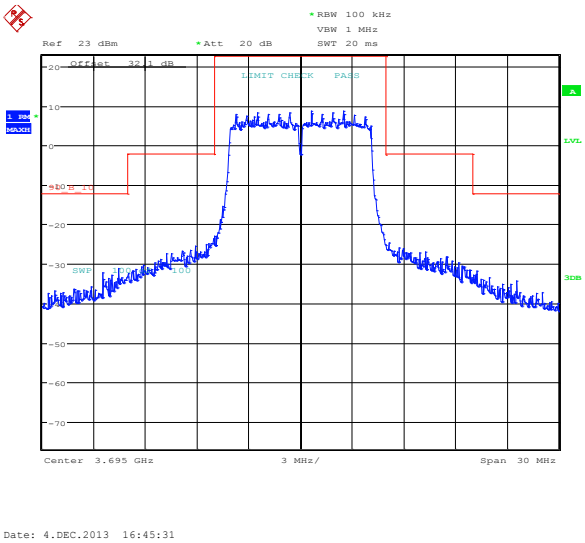


Figure 8.4-47: Emission mask at Port 2 10 MHz with 16-QAM, High channel

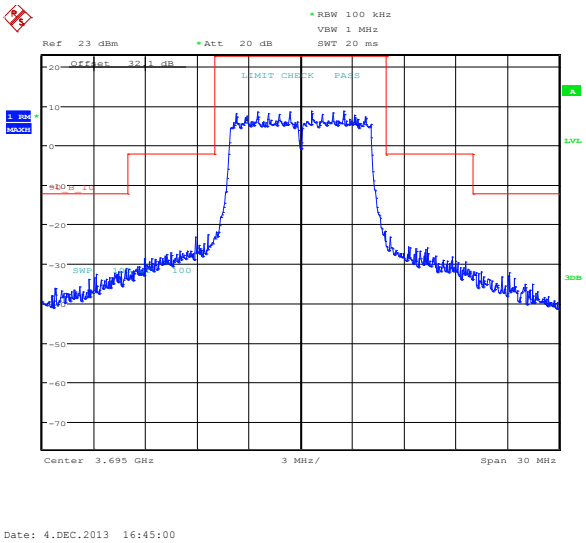


Figure 8.4-48: Emission mask at Port 2 10 MHz with 64-QAM, High channel

8.5 FCC 90.1323 Transmitter unwanted emissions

8.5.1 Definitions and limits

(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

8.5.2 Test summary

Test date:	December 4, 2013	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1003 mbar
Verdict:	Pass	Relative humidity:	34 %

8.5.3 Observations settings and special notes

The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment's channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1 % of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.
Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously. Radiated emissions were performed while both antenna connectors were terminated with 50 Ω load. No radiated spurious emissions were detected more than 15 dB below the limit.

Spectrum analyser settings for peak conducted measurements:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for band edge measurements:

Resolution bandwidth:	200 kHz (1 % of occupied bandwidth)
Video bandwidth:	2 MHz
Detector mode:	RMS
Trace mode:	Max-hold

8.5.4 Test data

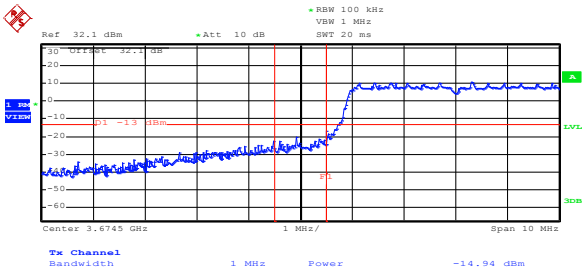


Figure 8.5-1: Lower band edge at 5 MHz Port 1 with BPSK

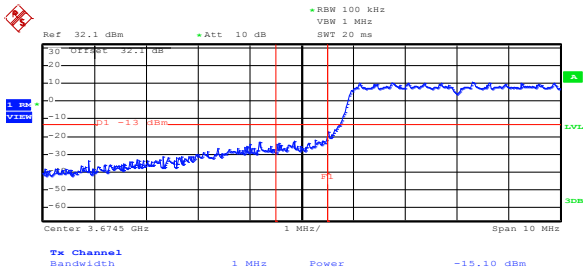


Figure 8.5-2: Lower band edge at 5 MHz Port 2 with 64-QAM

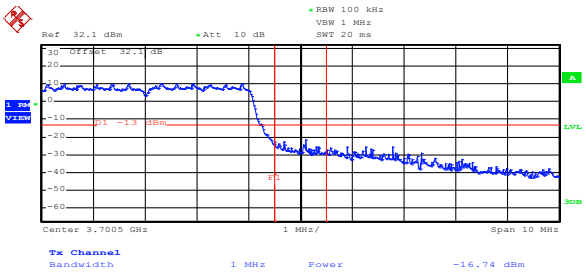


Figure 8.5-3: Upper band edge at 5 MHz Port 1 with QPSK

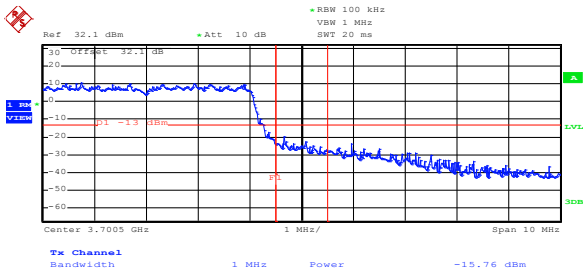


Figure 8.5-4: Upper band edge at 5 MHz Port 2 with 16-QAM

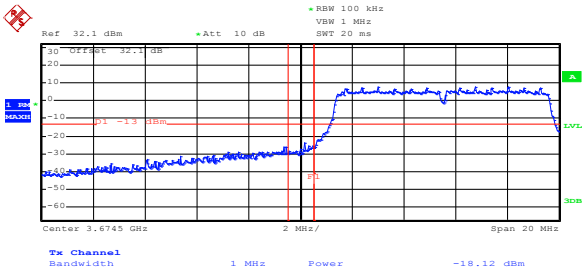


Figure 8.5-5: Lower band edge at 10 MHz Port 1 with BPSK

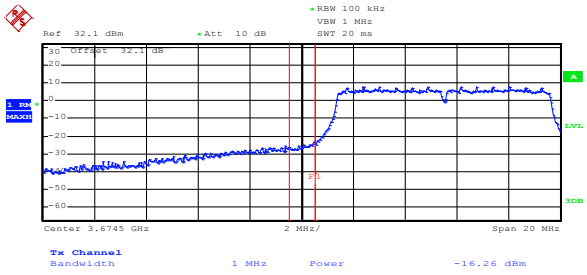


Figure 8.5-6: Lower band edge at 10 MHz Port 2 with 64-QAM

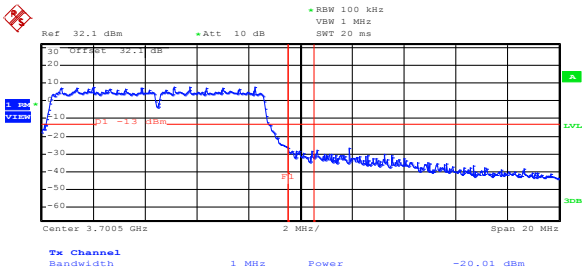


Figure 8.5-7: Upper band edge at 10 MHz Port 1 with QPSK

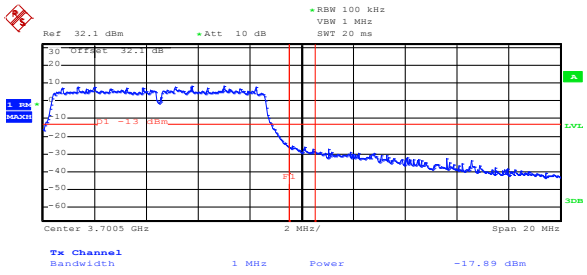
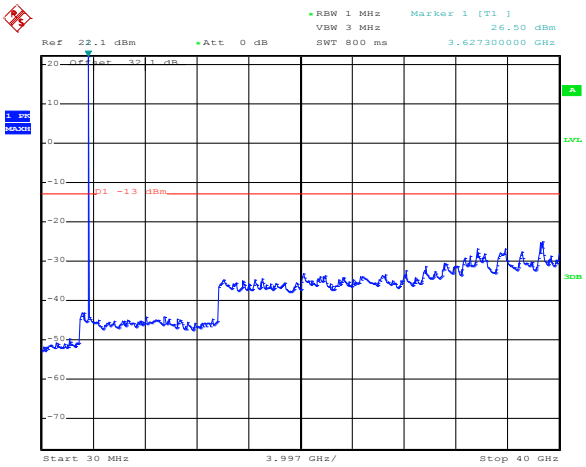


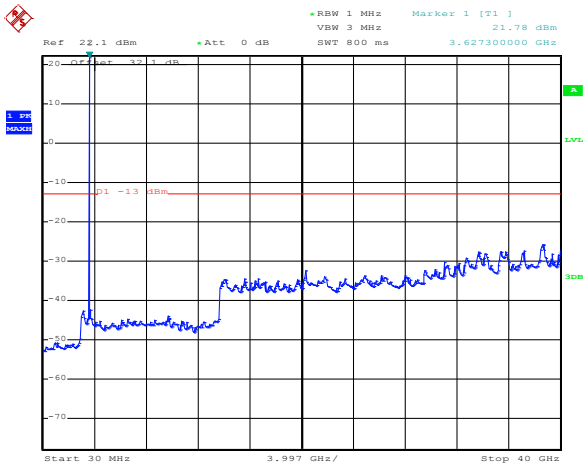
Figure 8.5-8: Upper band edge at 10 MHz Port 2 with 16-QAM

8.5.5 Test data, continued



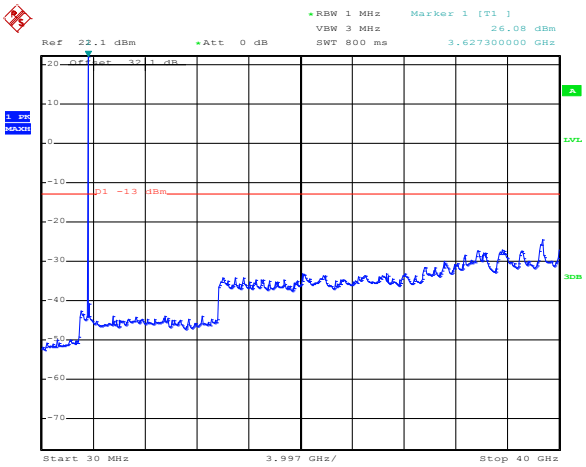
Date: 3.DEC.2013 20:39:03

Figure 8.5-9: Spurious out-of-band emissions at Port 1 with 5 MHz BPSK, low channel



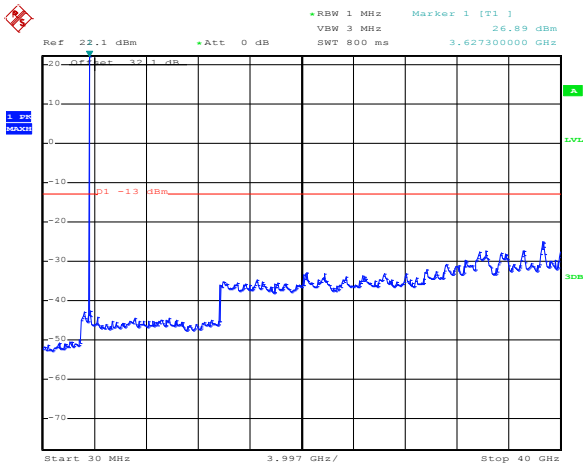
Date: 3.DEC.2013 20:42:35

Figure 8.5-10: Spurious out-of-band emissions at Port 1 with 5 MHz 64-QAM, low channel



Date: 3.DEC.2013 20:47:15

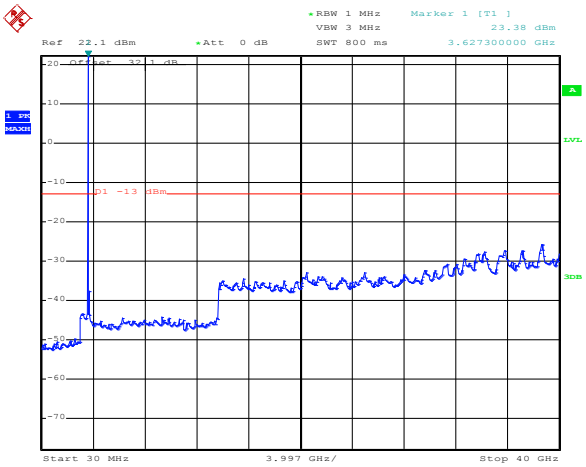
Figure 8.5-11: Spurious out-of-band emissions at Port 2 with 5 MHz BPSK, low channel



Date: 3.DEC.2013 20:43:25

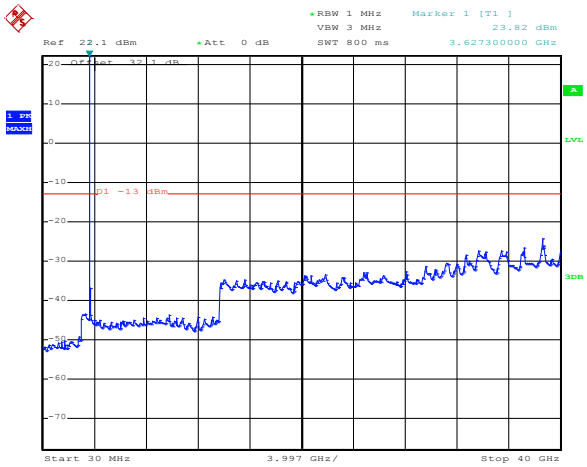
Figure 8.5-12: Spurious out-of-band emissions at Port 2 with 5 MHz 64-QAM, low channel

8.5.4 Test data, continued



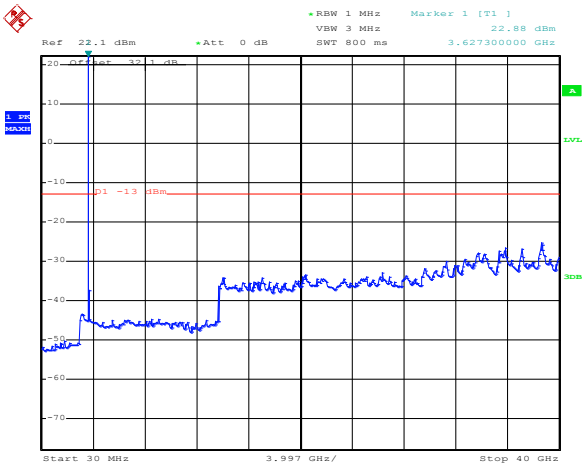
Date: 3.DEC.2013 20:39:55

Figure 8.5-13: Spurious out-of-band emissions at Port 1 with 5 MHz BPSK, mid channel



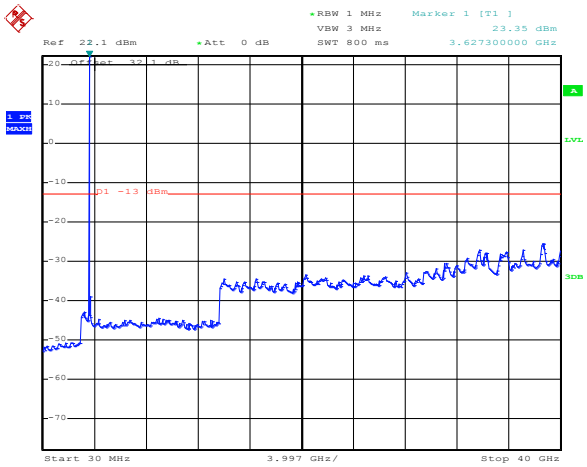
Date: 3.DEC.2013 20:42:00

Figure 8.5-14: Spurious out-of-band emissions at Port 1 with 5 MHz 64-QAM, mid channel



Date: 3.DEC.2013 20:45:57

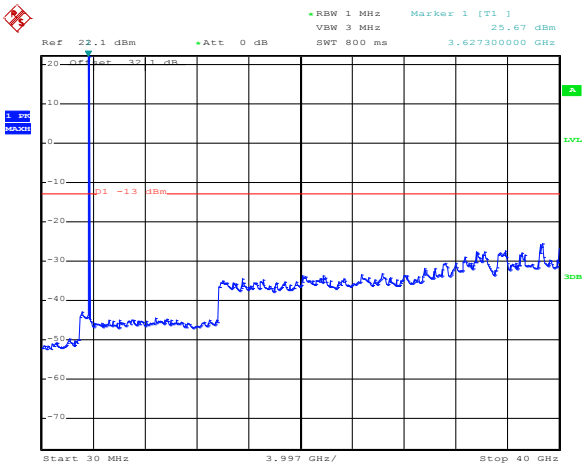
Figure 8.5-15: Spurious out-of-band emissions at Port 2 with 5 MHz BPSK, mid channel



Date: 3.DEC.2013 20:44:06

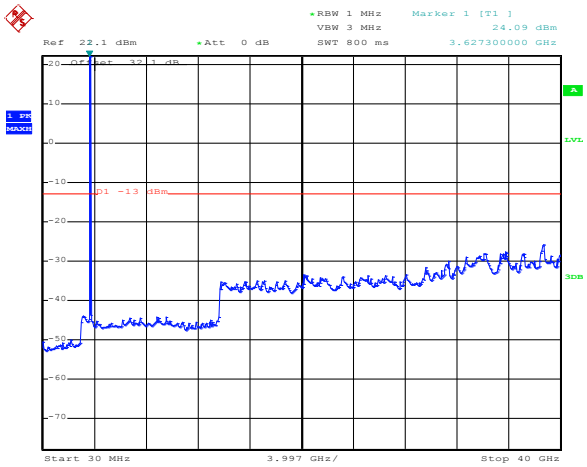
Figure 8.5-16: Spurious out-of-band emissions at Port 2 with 5 MHz 64-QAM, mid channel

8.5.4 Test data, continued



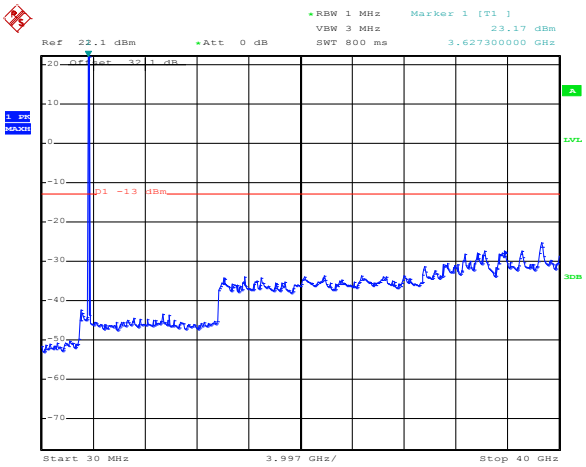
Date: 3.DEC.2013 20:40:36

Figure 8.5-17: Spurious out-of-band emissions at Port 1 with 5 MHz BPSK, high channel



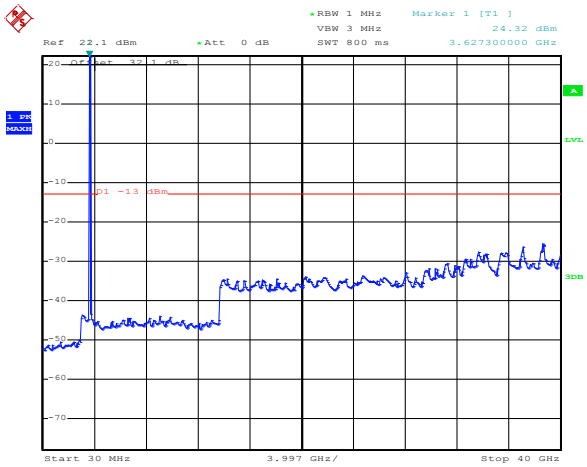
Date: 3.DEC.2013 20:41:11

Figure 8.5-18: Spurious out-of-band emissions at Port 1 with 5 MHz 64-QAM, high channel



Date: 3.DEC.2013 20:45:25

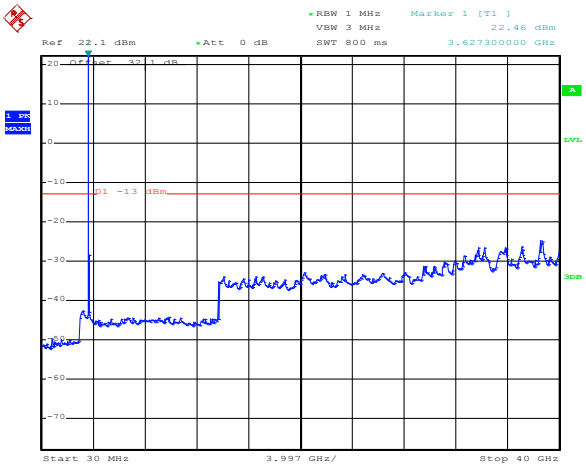
Figure 8.5-19: Spurious out-of-band emissions at Port 2 with 5 MHz BPSK, high channel



Date: 3.DEC.2013 20:44:43

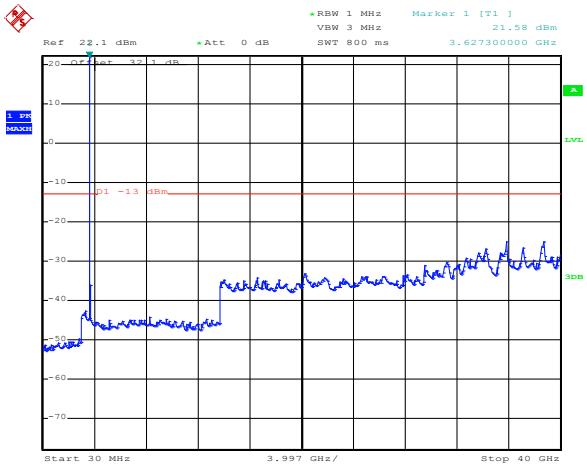
Figure 8.5-20: Spurious out-of-band emissions at Port 2 with 5 MHz 64-QAM, high channel

8.5.4 Test data, continued



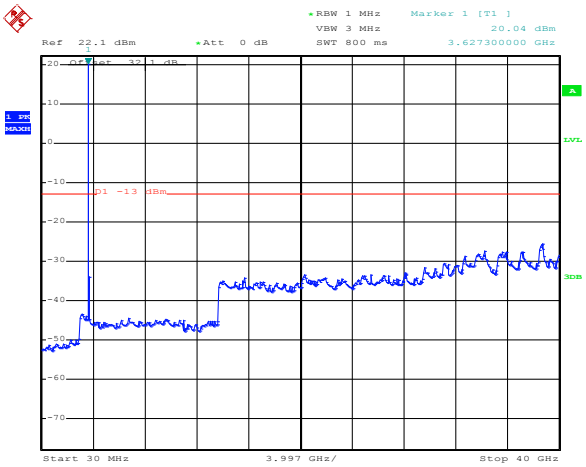
Date: 3.DEC.2013 20:34:42

Figure 8.5-21: Spurious out-of-band emissions at Port 1 with 10 MHz BPSK, low channel



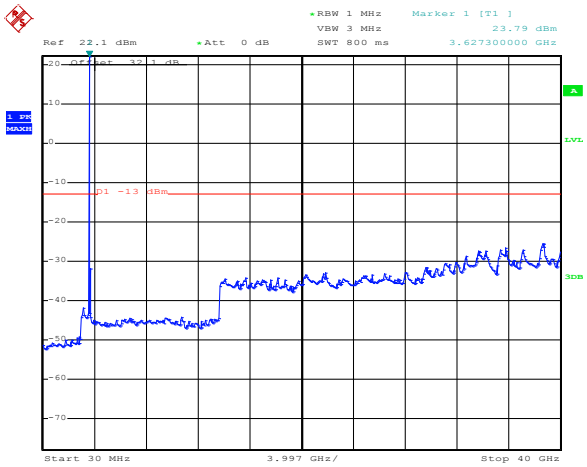
Date: 3.DEC.2013 20:32:47

Figure 8.5-22: Spurious out-of-band emissions at Port 1 with 10 MHz 64-QAM, low channel



Date: 3.DEC.2013 20:30:51

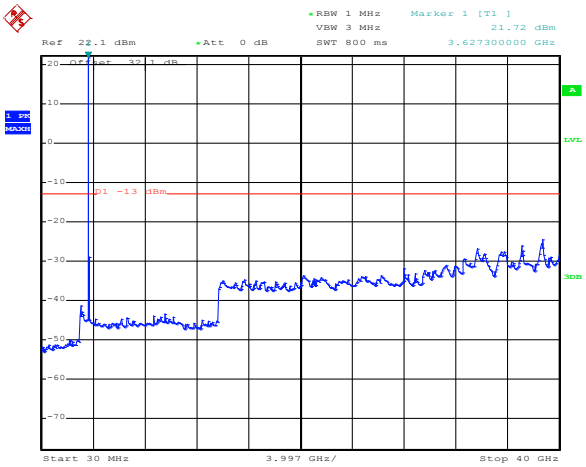
Figure 8.5-23: Spurious out-of-band emissions at Port 2 with 10 MHz BPSK, low channel



Date: 3.DEC.2013 20:31:34

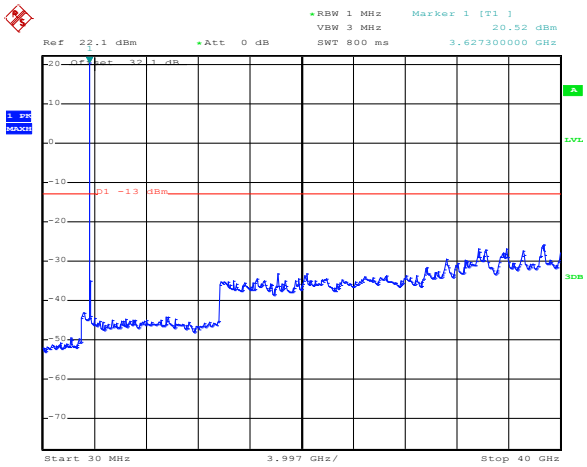
Figure 8.5-24: Spurious out-of-band emissions at Port 2 with 10 MHz 64-QAM, low channel

8.5.4 Test data, continued



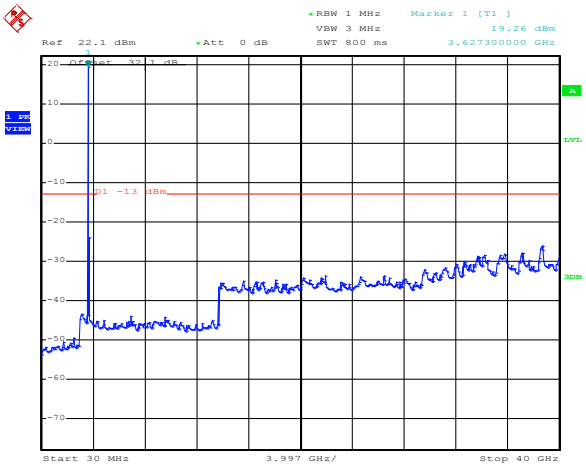
Date: 3.DEC.2013 20:35:22

Figure 8.5-25: Spurious out-of-band emissions at Port 1 with 10 MHz BPSK, mid channel



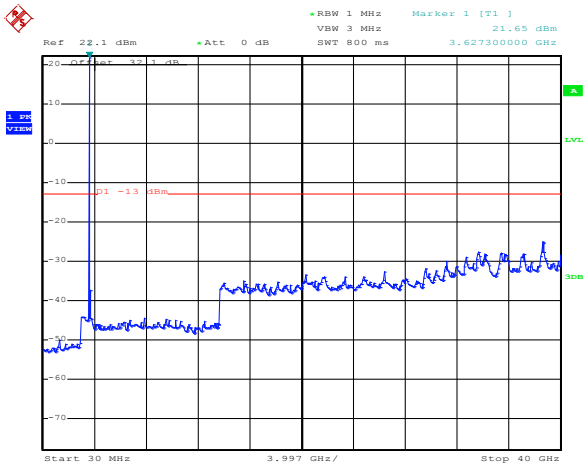
Date: 3.DEC.2013 20:35:56

Figure 8.5-26: Spurious out-of-band emissions at Port 1 with 10 MHz 64-QAM, mid channel



Date: 3.DEC.2013 20:29:59

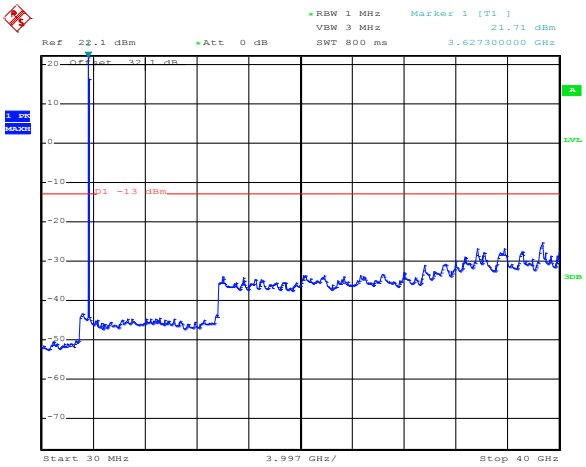
Figure 8.5-27: Spurious out-of-band emissions at Port 2 with 10 MHz BPSK, mid channel



Date: 3.DEC.2013 20:29:27

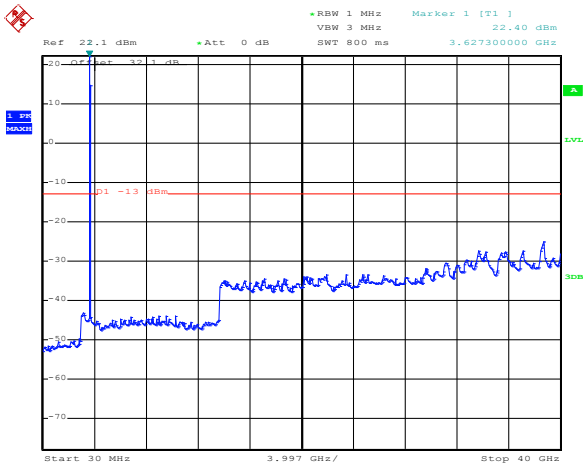
Figure 8.5-28: Spurious out-of-band emissions at Port 2 with 10 MHz 64-QAM, mid channel

8.5.4 Test data, continued



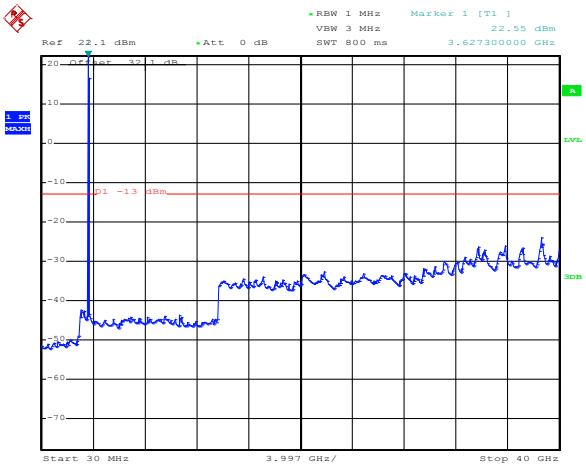
Date: 3.DEC.2013 20:37:36

Figure 8.5-29: Spurious out-of-band emissions at Port 1 with 10 MHz BPSK, high channel



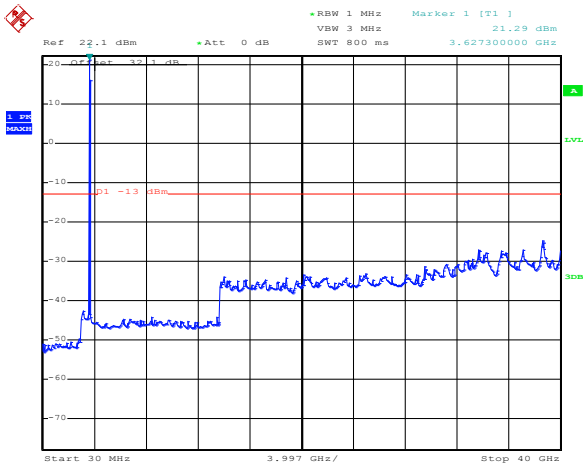
Date: 3.DEC.2013 20:36:55

Figure 8.5-30: Spurious out-of-band emissions at Port 1 with 10 MHz 64-QAM, high channel



Date: 3.DEC.2013 20:27:23

Figure 8.5-31: Spurious out-of-band emissions at Port 2 with 10 MHz BPSK, high channel



Date: 3.DEC.2013 20:28:22

Figure 8.5-32: Spurious out-of-band emissions at Port 2 with 10 MHz 64-QAM, high channel

8.5.4 Test data, continued

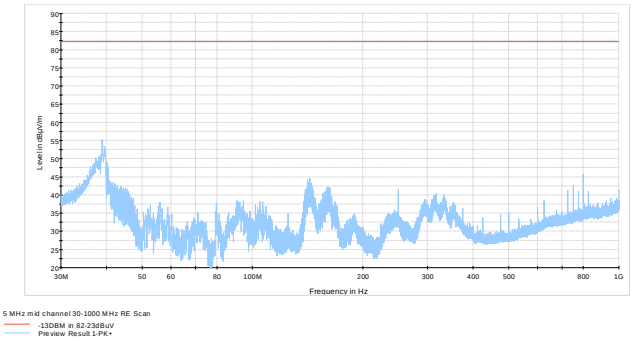


Figure 8.5-33: Spurious radiated emissions sample plot 30–1000 MHz, 5 MHz

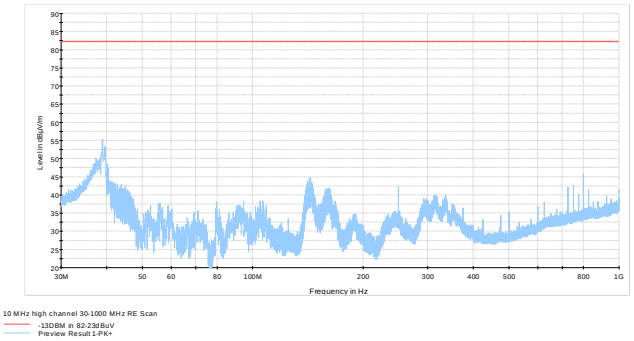


Figure 8.5-34: Spurious radiated emissions sample plot 30–1000 MHz, 10 MHz

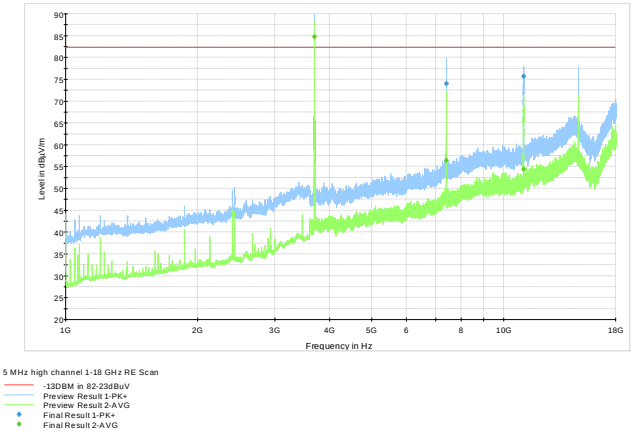


Figure 8.5-35: Spurious radiated emissions sample plot 1–18 GHz, 5 MHz

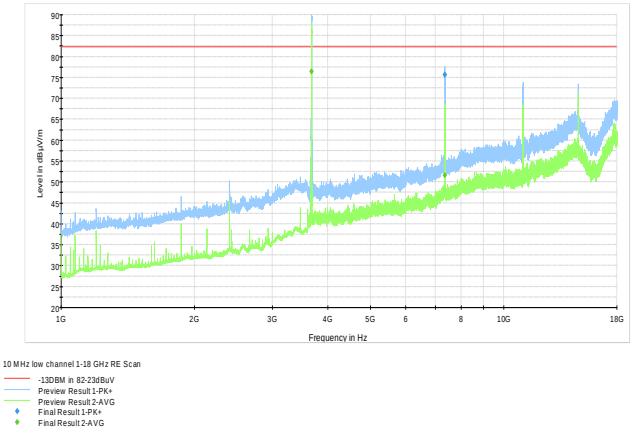


Figure 8.5-36: Spurious radiated emissions sample plot 1–18 GHz, 10 MHz

Table 8.5-1: EIRP measurements results

Channel	Frequency, MHz	Field strength dBµV/m	Substitution factor, dB	EIRP Level, dBm	EIRP Limit, dBm	Margin, dB
5 MHz High	7396.38	74.00	100.48	-26.48	-13.00	-13.48
5 MHz High	11093.16	75.60	95.63	-20.03	-13.00	-7.03
5 MHz low	7354.74	78.30	100.48	-22.18	-13.00	-9.18
5 MHz Mid	7368.54	74.40	100.48	-26.08	-13.00	-13.08
5 MHz Mid	11053.26	76.30	95.63	-19.33	-13.00	-6.33
10 MHz High	11091.57	72.90	95.63	-22.73	-13.00	-9.73
10 MHz Low	7358.04	75.70	100.48	-24.78	-13.00	-11.78

Note: EIRP is a product of the calculation of Signal Generator minus the Cable plus Antenna Gain.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up